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RESEARCH ARTICLE
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"CEREBELLOPONTINE ANGLE TUMORS IN THE SITTING POSITION: A PROSPECTIVE EVALUATION OF CLINICORADIOLOGICAL, HISTOPATHOLOGICAL CORRELATION AND SURGICAL OUTCOMES VIA THE RETROSIGMOID APPROACH"

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Abstract

Background:
Cerebellopontine angle (CPA) tumors represent 5–10% of all intracranial neoplasms, most commonly vestibular schwannomas, followed by meningiomas and epidermoid cysts. Advances in microsurgical and anesthetic techniques have significantly improved outcomes, shifting the focus from mere excision to functional preservation.

Objective:
To evaluate the clinico-radiological and histopathological characteristics, surgical outcomes, and prognostic factors influencing results in patients with CPA tumors.

Methods:
This prospective study included 40 patients with CPA tumors who underwent surgical treatment at the Department of Neurosurgery, G.R. Medical College, Gwalior, between January 2023 and September 2024. Clinical features, MRI findings, surgical approach, extent of resection, postoperative complications, and outcomes were analyzed. Facial nerve function was graded using the House–Brackmann scale, and hearing was assessed by pure-tone audiometry. Statistical analysis was performed using SPSS version 20.0.

Results:
The mean age was in the 3rd–5th decade, with a slight male predominance (52.5%). Sensorineural hearing loss (90%), headache (87.5%), and cerebellar signs (82.5%) were the most common symptoms. Vestibular schwannoma was the predominant histopathology (82.5%). Gross total excision was achieved in 82.5% of cases, near-total in 10%, and subtotal in 7.5%. Anatomical preservation of the facial nerve was achieved in 80.6% of patients. CSF leak occurred in 5%,

meningitis in 10%, and overall mortality was 5%. Recurrence occurred in two patients (5.26%) during follow-up.

Conclusion:

Cerebellopontine angle (CPA) tumors predominantly affected middle-aged individuals with a slight male preponderance. Most patients presented with hearing loss, headache, and cerebellar symptoms, and the majority had giant lesions with non-serviceable hearing. Vestibular schwannoma was the most common histopathological type. The retrosigmoid approach in the semi-sitting position provided excellent exposure and high rates of gross total excision. Advances in microsurgical techniques have improved facial nerve preservation and functional outcomes, though facial nerve palsy remained the most frequent complication. Cerebrospinal fluid (CSF) leak and meningitis persisted as major causes of morbidity and accounted for a postoperative mortality rate of 5%.

Keywords: Cerebellopontine angle tumors; Vestibular schwannoma; Meningioma; Epidermoid ; Retrosigmoid approach; Facial nerve preservation; Post-operative complication.

INTRODUCTION

Cerebellopontine angle (CPA) tumors account for 5–10% of intracranial neoplasms [1,2]. Most are benign, with vestibular schwannomas comprising >85%, followed by meningiomas (5–10%) and epidermoid cysts (5–7%) [3]. Other rare lesions include metastases, arachnoid cysts and neurenteric cysts, vascular malformations, and cranial nerve neuromas. Symptoms result from mass effect or cranial nerve compression, and vary with size, growth, and location. Vestibular schwannomas usually cause unilateral sensorineural hearing loss, tinnitus, and imbalance, while meningiomas more often involve CN V and X, producing facial numbness, neuralgia, and dysphagia. Epidermoids mimic these features [4,5]. MRI is the gold standard for diagnosis, offering superior soft tissue contrast and delineation of the lesion's relation to the IAC, brainstem, and cerebellum [6]. Management depends on tumor size, growth, and patient profile. Observation is reasonable for small asymptomatic lesions, whereas surgery, stereotactic radiosurgery, or radiotherapy are preferred for larger or symptomatic tumors [7]. Several surgical approaches are utilized depending on tumor location and surgeon preference. These include the retrosigmoid (suboccipital), translabyrinthine, middle fossa, transcochlear, transotic, and retrolabyrinthine routes. Among these, the retrosigmoid approach is widely used, providing broad CPA exposure with good facial nerve preservation . The sitting position with neck flexion provides gravity assisted cerebellar relaxation ,improved surgical exposure with clearer anatomical orientation, improved venous and CSF drainage and a bloodless field thereby reducing the need for retraction, enhanced surgeon comfort and less fatigue and potentially better facial nerve preservation and improved airway management but at the cost of potentially life-threatening complications like air embolism**,** cardiovascular compromise and cervical cord injury[8,9]. Proper anesthetic monitoring, restricted neck flexion, and team experience are essential for safe use. Modern microsurgical techniques with intraoperative monitoring have reduced morbidity, enabling safe resection with favorable functional outcomes.

AIMS: "A Prospective study on Clinico-Radiological, Histo-Pathological correlation and surgical outcomes and prognostic factors in patients with Cerebellopontine angle tumors"

OBJECTIVES:

1. To evaluate the clinico-radiological , Histo-pathological features of patients with Cerebellopontine angle tumors including age , sex , duration of symptoms, neurological status and imaging findings such as MRI and CT scans.
2. To determine the surgical outcomes of patients with Cerebellopontine angle tumors including mortality, morbidity, length of hospital stay and postoperative complications such as cranial nerve deficit, hydrocephalous, hematoma, wound infections etc.

3. To identify prognostic factors that can predict the outcome of surgery in patients with Cerebellopontine angle tumors including age, sex, duration of symptoms, neurological status, extent of involvement and comorbidities.

Materials and Methods

Study Design and Setting

This prospective study was conducted in the Department of Neurosurgery, Jayarogya Group of Hospitals, Gajra Raja Medical College (G.R.M.C.), Gwalior, Madhya Pradesh. A total of 40 patients with cerebellopontine angle (CPA) tumors who underwent surgical treatment between January 2023 and September 2024 were included in the study.

Inclusion Criteria

1. Patients aged >18 years diagnosed with CPA tumors by clinical evaluation and radiological imaging (CT/MRI).
2. Patients willing to participate and provide informed consent.
3. Patients who underwent surgical treatment for CPA tumors.

Exclusion Criteria

1. Patients with recurrent CPA tumors.
2. Patients unwilling to participate in the study.
3. Patients with tumors other than CPA tumors.
4. Patients with CPA tumors who did not undergo surgery.

Ethical Approval

The study protocol was approved by the Institutional Ethical Committee (Medical), and informed consent was obtained from all participants.

Methodology

All patients were evaluated based on age, sex, clinical presentation, imaging characteristics, and tumor resectability. Preoperative MRI was performed in all cases, assessing:

- Signal characteristics on T1- and T2-weighted images
- Contrast enhancement pattern
- Calcifications
- Lesion margins
- Features on Diffusion Weighted Imaging (DWI) and Apparent Diffusion Coefficient (ADC) sequences

Functional Assessments

- Facial nerve function was evaluated using the House-Brackmann grading system [10], preoperatively, at discharge, and during follow-up.
- Hearing assessment was done using Pure Tone Audiometry (PTA). Useful hearing was defined as hearing loss <50 dB according to Gardner-Robertson modification of the Silverstein [11] and Norell classification[12]. Postoperative hearing was assessed only in those with useful preoperative hearing.
- Fundoscopy was performed using a direct ophthalmoscope to detect papilledema, graded using the modified Frisen scale.
- Ventriculoperitoneal (V-P) shunting was performed preoperatively in patients with hydrocephalus.

Surgical Approach and Technique

- All surgeries aimed for radical excision using an operating microscope.

- The suboccipital retro-mastoid craniectomy approach was employed in all patients, following standard microsurgical techniques [13,14].
- Patients received perioperative and postoperative corticosteroids.

Extent of Resection and Outcome Assessment

The extent of tumor removal was determined intraoperatively and confirmed with postoperative CT/MRI scans and was classified as:

- Gross Total Excision (GTR)
- Near Total Excision (NTR)
- Subtotal Excision (STR)

Tumor size was measured on MRI along two axes: one parallel to the petrous ridge and the other vertical in the coronal plane. The largest vertical diameter was considered for categorizing tumor size. Based on this measurement, tumors were classified into four categories:

- Small: < 1.5 cm
- Medium: 1.5–3 cm
- Large: 3–4 cm
- Giant: > 4 cm

This classification was used for further correlation with clinical presentation and surgical outcomes[15].

Postoperative Evaluation and Follow-up

- Morbidity was defined as new cranial nerve or other neurological deficits.
- Mortality and other complications were also documented.
- Histopathological findings were compared with preoperative radiological diagnoses.
- Patients were followed up for 3 months,6 months and at 1 year postoperatively.

Data Analysis

Data were compiled and analyzed using SPSS software, version 20.0, and summarized using descriptive statistics. Results were represented in tabular form.

OBSERVATIONS AND RESULTS:

Table No.1: Distribution of cases according to Histopathology.

Histopathology	Number of Patients	Percentage
Vestibular Schwannoma	33	82.50%
Meningioma	3	7.50%
Epidermoid	4	10%

Table No.2: Distribution of cases according to Sex.

Sex	Vestibular Schwannoma	Meningioma	Epidermoid	Total Patients	Percentage
Male	18	1	2	21	52.50%
Female	15	2	2	19	47.50%

Table No.3 : Distribution of Tumors according to Age.

Age Group	Vestibular Schwannoma	Meningioma	Epidermoid	Total Patients	Percentage
21-30	7	0	3	10	25.00%
31-40	9	1	0	10	25.00%
41-50	9	1	0	10	25.00%
51-60	5	0	1	6	15.00%
61-70	3	1	0	4	10.00%

Table No.4 : Distribution of cases according to clinical presentations

Clinical findings	Vestibular Schwannoma	Meningioma	Epidermoid	Total Patients	Percentage
Headache	28	3	4	35	87.50%
Tinnitus	11	2	1	14	35.00%
Vertigo	27	0	2	29	72.50%
Sensorineural hearing loss	30	3	3	36	90.00%
Cerebellar signs	26	3	4	33	82.50%
Papilloedema	19	3	1	23	57.50%
Trigeminal nerve Dysfunction	17	1	1	19	47.50%
Facial nerve Dysfunction	25	3	2	30	75.00%
9,10,11 Nerve Dysfunction	6	0	0	6	15.00%

Table No.5 : Distribution of cases according to Pure Tone Audiometry

Class	**No. of patients**	**Percentage**
I & II (Serviceable)	8	20.00%
III & IV (Non- Serviceable)	32	80.00%

Table 6. Distribution of cases according to finding on MRI Imaging

Findings (MRI)	Vestibular Schwannoma (33)	Meningioma (3)	Epidermoid cyst (4)
Homogenous enhancement	2	3	0
Heterogenous enhancement	31	0	0
Cystic Component	31	0	0
Centred of IAM	29	1	0
Broad base dural tail	0	3	0
Diffusion weighted imaging	0	0	4

Table No.7 : Distribution of cases according to Facial Nerve Functional Grading

Grade	Pre-op (n=30)	Post-Op (n=38)						Follow up Grade (n=33)					
		1	2	3	4	5	6	1	2	3	4	5	6
1	10	2	5	3	0	0	0	2	5	0	0	0	0
2	28	0	19	7	2	0	0	2	20	5	1	0	0
3	2	0	0	2	0	0	0	0	2	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0

Table No.8 : Distribution of cases according to surgical procedure

Surgical Procedure	No. of Patients	Percentage
VP shunt + Tumor Surgery	23	57.50%
Direct Tumor surgery	17	42.50%

Table No.9: Distribution of cases according to Resectability

Tumor	Sub Total Excision	Near Total Excision	Gross Total Excision
Vestibular Schwannoma(n=33)	2 (6.06%)	3 (9.09%)	28 (84.85%)
Meningioma (n=3)	0	1 (33.33%)	2 (66.67%)
Epidermoid (n=4)	0	1 (25%)	3 (75%)

Table No. 10 : Distribution of cases according to Size of Tumor

Size	No. of Patients	Percentage
Medium (15-30mm)	0	0
Large (31-40 mm)	14	35.00%
Giant (>40mm)	26	65.00%

Table No.11 : Distribution of cases according to Anatomical Preservation of Facial nerve in entire group.

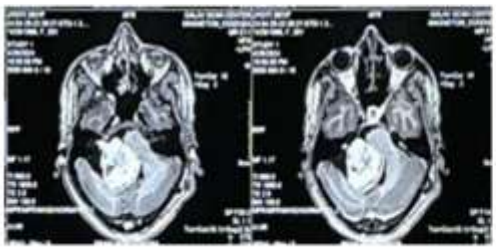
Size	No. of Patients	Percentage
Medium (15-30mm)	0	0
Large(30-40mm)	11(14)	78.57%
Giant (>40mm)	16(26)	61.54%

Table No.12 : Distribution of cases according to Complications

Complications	Vestibular schwannoma	Meningioma	Epidermoid	No. of Patients	Percentage
CSF leak	1	0	1	2	5.00%
Meningitis	2	1	1	4	10.00%
Hematoma	4	0	0	4	10.00%
Lower Cranial Nerve Palsy	5	1	1	7	17.50%
Venous air embolism	0	0	0	0	0%
Mortality	2	0	0	2	5.00%

VESTIBULAR SCHWANNOMA

PRE-OP



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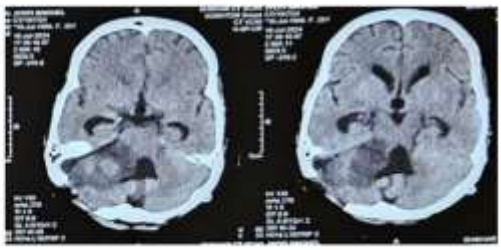
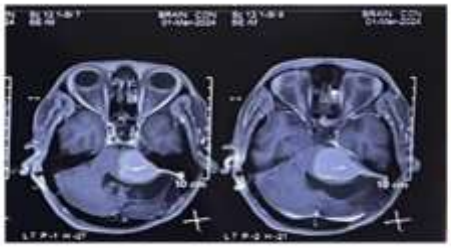


MENINGIOMA

PRE-OP



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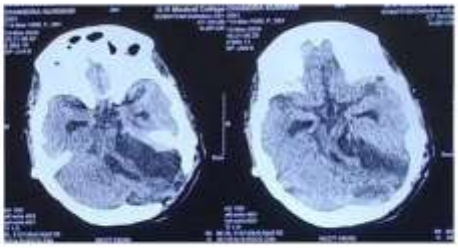

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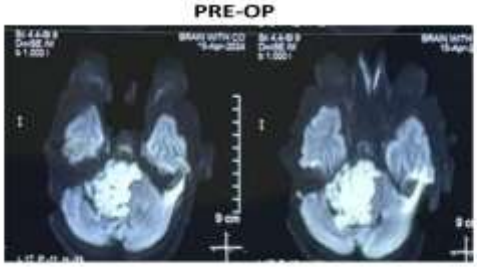

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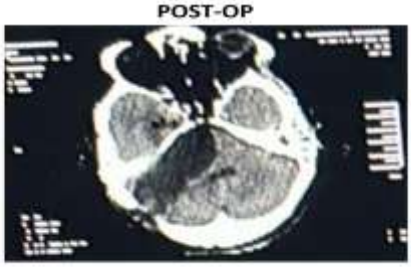

DISCUSSION:

There has been a considerable evolution in the management of cerebellopontine angle (CPA) tumors, especially vestibular schwannomas (VS). Historically, Harvey Cushing was the first to significantly reduce the surgical mortality from 50% to 11%[16]. Subsequently, Walter Dandy reported complete excision without mortality. The introduction of the operating microscope in 1964–1965 by pioneers such as House[10], Rand, and Kurze[17], along with advancements in microsurgical techniques and modern anesthesia, shifted the primary goal of VS surgery from mere excision to functional preservation—particularly of the facial and cochlear nerves.

In our study, the majority of patients were in the 3rd to 5th decades of life. Males constituted 52.5% and females 47.5%. This contrasts with Arismendi et al., who reported a 2:1 female-to-male ratio with a median age of 48 ±12.7 years. Memari et al. [18] showed a slight male predominance (55%) and mean age of 49 years, while Joarder et al. [19] reported peak incidence between 30–50 years with female predominance (55%). Maheswararao et al. [20] noted a peak incidence in the 51–60 age group with 70% being female.

Sensorineural hearing loss (SNHL) was the most common presenting symptom (90%), followed by headache (87.5%), cerebellar signs (82.5%), facial nerve dysfunction (75%), trigeminal nerve involvement (47.5%), papilledema (57.5%), tinnitus (35%), and lower cranial nerve involvement (15%). Pure tone audiometry revealed serviceable hearing in 20% of cases and non-serviceable in 80%. These findings are comparable to studies by Memari et al. [18] and Joarder et al.[19].

Large tumors (26–40 mm) were seen in 35% and giant tumors (>40 mm) in 65% of cases. Memari et al. [18] reported a mean tumor size of 24 mm (range up to 35 mm), while Joarder et al. [19] observed 15% medium-sized, 58% large, and 27% giant tumors.

Radiologically, 31 cases showed heterogeneous enhancement and cystic components; only two had homogeneous enhancement. None showed hyperostosis. Among meningiomas, homogeneous enhancement and dural tail were present in 3 cases each. All epidermoids showed restricted diffusion on DWI with no enhancement or cystic component, aligning with Maheswararao et al. [20].

A ventriculoperitoneal (VP) shunt was performed prior to definitive surgery in 57.5% of cases; 42.5% underwent direct surgery. Suboccipital retro-mastoid approach in semi-sitting position was used in all 40 cases without any positioning-related complications. AC drilling was done in all cases of VS (33 cases).

In VS cases, gross total excision was achieved in 84.85%, near-total in 9.09%, and subtotal in 6.06%. Meningiomas had 66.67% gross total and 33.3% near-total excision. Epidermoids were 75% gross total and 25% near-total. Overall gross total resection rate was 82.5%. These outcomes are consistent with Memari et al. [18] (92% gross total resection) and Sourabh Dixit et al. [21] (84.61% gross total). Adherence of tumour with brainstem and facial nerve were responsible for near total and subtotal resection in few cases.

Anatomical preservation of the facial nerve was achieved in 78.57% of large tumors and 61.54% of giant tumors, with an overall preservation rate of 80.6%. Joarder et al. [19] reported 75% and 55% for large and giant tumors respectively. Samii and Matthias [22] achieved a preservation rate of 93% regardless of tumor size, and Jain et al. [23] reported 84.3%.

Preoperative facial nerve palsy was present in 30 patients (28 grade II, 2 grade III). Postoperatively, 7 patients worsened to grade III and 2 to grade IV. Samii et al. [22] reported postoperative House-Brackmann grades I–II in 64%, III–IV in 21%, and V–VI in 15% of cases.

CSF leak occurred in 5% and was managed conservatively with lumbar drain and medication. Meningitis developed in 10%, with 2 deaths attributed to it, meningitis treated with appropriate antibiotics. Lower cranial nerve palsy occurred in 32.5% (15% new onset) They were managed with nasogastric tube feeding.

Compared to Jain et al. [23] (6.8% incidence) and Dixit et al. [21] (46.15% transient palsy) our figures are slightly higher, possibly due to larger tumors and more complex cases.

Hearing preservation was achieved in 37.5% of the 8 patients who had preoperative serviceable hearing. This is relatively higher than Samii et al. [22] (23.6%) and Jain et al. (29.6%) [23].

At 6-month follow-up, recurrence was noted in two patients (5.26%)—one each of vestibular schwannoma and meningioma. Both opted for conservative management. In comparison, Memari et al. [18] , noted 7% residual tumor and Gormley and Sekhar et al. [24] reported no recurrence with complete resection.

Overall postoperative mortality was 5%, mainly due to complications of meningitis following CSF leak. This is slightly higher than Memari et al. [19] 2% mortality for the retrosigmoid approach.

The average length of hospital stay was 12-14 days.

CONCLUSION

Cerebellopontine angle (CPA) tumors predominantly affected middle-aged individuals with a slight male preponderance. Most patients presented with hearing loss, headache, and cerebellar symptoms, and the majority had giant lesions with non-serviceable hearing. Vestibular schwannoma was the most common histopathological type. The retrosigmoid approach in the semi-sitting position provided excellent exposure and high rates of gross total excision. Advances in microsurgical techniques have improved facial nerve preservation and functional outcomes, though facial nerve palsy remained the most frequent complication. Cerebrospinal fluid (CSF) leak and meningitis persisted as major causes of morbidity and accounted for a postoperative mortality rate of 5%.

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