



CLINICAL SPECTRUM, SURGICAL MANAGEMENT, AND SHORT-TERM OUTCOMES OF POSTERIOR FOSSA TUMORS: A PROSPECTIVE OBSERVATIONAL STUDY

Neurosurgery

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ABSTRACT

Background: Posterior fossa tumors arise within a compact compartment containing the cerebellum, brainstem, fourth ventricle, cranial nerves and major vessels, so even small lesions may cause obstructive hydrocephalus or brainstem dysfunction. Prospective Indian data on mixed adult and pediatric cohorts remain limited. **Objective:** To evaluate the clinical presentation, radiological profile, surgical management, histopathology and three-month outcomes of patients undergoing surgery for posterior fossa tumors. **Materials and Methods:** A prospective observational study was conducted from January 2025 through June 2026 at a tertiary government teaching hospital in South India. Forty consecutive patients of any age or sex with a posterior fossa tumor were enrolled. Contrast-enhanced magnetic resonance imaging (MRI) was the principal imaging modality and histopathology the reference diagnosis. Surgical approach, extent of resection, complications, need for cerebrospinal fluid (CSF) diversion and outcome at discharge and three months were recorded. Analysis used SPSS version 26.0, with a two-sided P value <0.05 considered significant. **Results:** Mean age was 39.7 ± 18.8 years and 20 patients (50.0%) were male. Cerebellopontine angle (CPA) tumors predominated (55.0%). Cerebellar signs were present in 95.0%, cranial-nerve deficits in 70.0% and hydrocephalus in 42.5%. The retrosigmoid approach was used in 62.5%, and gross-total or near-total resection was achieved in 72.5%. Vestibular schwannoma was the commonest histology (37.5%) and 72.5% of tumors were WHO grade 1. Hydrocephalus strongly predicted the need for CSF diversion (76.5% versus 0%; $P < 0.001$). Postoperative complications occurred in 57.5%; 72.5% improved at discharge and mortality was 5.0%. Good recovery at three months was lower in patients with complications (43.5% versus 82.4%; $P = 0.013$). **Conclusion:** Posterior fossa tumors showed marked age- and anatomy-dependent heterogeneity, with CPA lesions predominating. MRI-guided planning and maximal safe resection yielded favorable short-term outcomes; hydrocephalus determined CSF diversion and complications predicted poorer early recovery.

KEYWORDS

Posterior Fossa Tumors; Cerebellopontine Angle; Hydrocephalus; Retrosigmoid Approach; Vestibular Schwannoma; Surgical Outcome

INTRODUCTION

Posterior fossa tumors are clinically heterogeneous lesions arising within a compact compartment containing the cerebellum, brainstem, fourth ventricle, cranial nerves and major vascular structures. Contemporary classification increasingly integrates histology and molecular features, while epidemiology varies substantially with age.[1,2]

Because relatively small lesions may cause obstructive hydrocephalus or brainstem and cranial-nerve dysfunction, timely diagnosis and maximal safe resection are central to management. Indian prospective data describing mixed adult-pediatric case profiles, perioperative complications and short-term outcomes remain limited. We therefore evaluated the presentation, radiological profile, surgical treatment, histopathology and three-month outcomes of patients with posterior fossa tumors.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was performed from January 2025 through June 2026 in the Department of Neurosurgery of a tertiary government teaching hospital in South India.

Participants: Forty consecutive patients of any age or sex with a diagnosis of posterior fossa tumor and written informed consent were included. Patients unwilling to participate or with severe medical comorbidity precluding surgery were excluded.

Methods: All patients underwent standardized history taking and neurological examination. Contrast-enhanced magnetic resonance imaging was the principal imaging modality; computed tomography was obtained where indicated. Tumor location, laterality, maximum dimension, hydrocephalus, brainstem relationship and preoperative imaging impression were recorded. Surgical approach and extent of resection were documented. Histopathology was considered the reference diagnosis. Patients were followed during admission and for three months after surgery for complications, need for cerebrospinal fluid (CSF) diversion or adjuvant treatment, and clinical outcome.

Statistical Analysis: Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean $\pm$ standard deviation and categorical variables as number and percentage. Chi-square or Fisher exact tests were used for categorical associations, Student t test for two-group continuous comparisons, one-way analysis of variance for multiple continuous groups and Kruskal-Wallis testing where appropriate. A two-sided P value <0.05 was considered statistically significant.

Ethical Considerations: Institutional Ethics Committee approval was obtained before enrollment (GMC/IEC/04/2025, dated 20 January 2025). Written informed consent was obtained from all participants or their guardians, as applicable, including consent for publication of clinical images.

RESULTS

The cohort included 40 patients with a mean age of 39.7 ± 18.8 years (range 0.5-67 years); 20 (50.0%) were male. Twenty patients (50.0%) were aged 41-60 years. Cerebellopontine angle (CPA) tumors were the dominant category (22/40, 55.0%), followed by metastatic tumors (15.0%) and medulloblastoma (7.5%). Cranial-nerve deficits were present in 70.0%, cerebellar signs in 95.0% and hydrocephalus in 42.5% (Table 1, Figure 1).

Table 1: Baseline Clinical and Radiological Characteristics (n = 40)

Variable	Value
Age, years, mean $\pm$ SD	39.7 $\pm$ 18.8
Age range, years	0.5-67
Age 41-60 years, n (%)	20 (50.0)
Male sex, n (%)	20 (50.0)
Mean symptom duration, months	5
Presenting symptom complex, n (%)	
Hearing loss / tinnitus predominant	11 (27.5)
Headache with vomiting and ataxia	10 (25.0)
Clinical findings, n (%)	

Cerebellar signs	38 (95.0)
Cranial-nerve deficits	28 (70.0)
Hydrocephalus	17 (42.5)
Tumor category, n (%)	
Cerebellopontine angle tumor	22 (55.0)
Metastatic tumor	6 (15.0)
Medulloblastoma	3 (7.5)
Other / remaining histologies	9 (22.5)
Preoperative imaging impression of CPA space-occupying lesion, n (%)	22 (55.0)

SD = standard deviation; CPA = cerebellopontine angle.

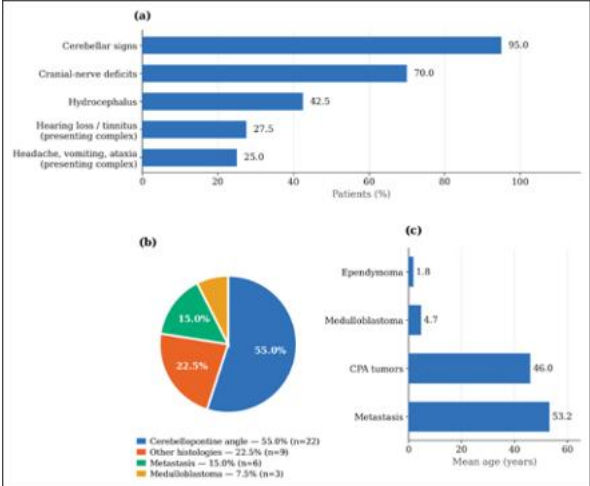


Figure 1: Clinical and radiological profile of the study cohort (n = 40). (a) Frequency of clinical findings and of the two commonest presenting symptom complexes; these categories are not mutually exclusive, so the values do not sum to 100%. (b) Distribution of tumor category. (c) Mean age at presentation by tumor category (P = 0.002). CPA = cerebellopontine angle.

Hearing loss and tinnitus-predominant symptoms (27.5%) and headache with vomiting and ataxia (25.0%) were the most common presenting complexes. Mean symptom duration was five months. The CPA was the commonest anatomical site, and 57.5% of tumors were right or left CPA lesions. Preoperative imaging identified a CPA space-occupying lesion in 55.0% and generally corresponded closely with final histopathology, particularly for CPA pathology (Figure 2).

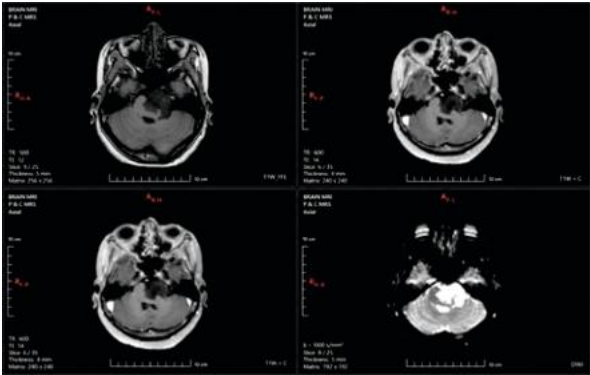


Figure 2: Magnetic resonance imaging of the brain showing a posterior fossa epidermoid tumor. Axial images demonstrate a well-defined extra-axial lesion in the prepontine/cerebellopontine angle region, hypointense on T1-weighted imaging (a) and showing no significant enhancement on post-contrast T1-weighted imaging (b, c). The lesion demonstrates marked diffusion restriction with high signal on diffusion-weighted imaging (d). The imaging characteristics are consistent with an epidermoid tumor.

The retrosigmoid approach was used in 25 patients (62.5%), followed by midline suboccipital surgery in 10 (25.0%). Gross-total resection was achieved in 14 (35.0%), near-total resection in 15 (37.5%), subtotal resection in 9 (22.5%) and biopsy alone in 2 (5.0%) (Table 2, Figure 3). Mean tumor size did not differ significantly by extent of resection (P=0.502). A representative operative sequence is shown in Figure 4.

Table 2: Surgical Management and Histopathological Profile (n = 40)

Variable	n (%)
Surgical approach	
Retrosigmoid	25 (62.5)
Midline suboccipital	10 (25.0)
Other approaches	5 (12.5)
Extent of resection	
Gross-total resection	14 (35.0)
Near-total resection	15 (37.5)
Subtotal resection	9 (22.5)
Biopsy only	2 (5.0)
Cerebrospinal fluid diversion	
Preoperative external ventricular drain	6 (15.0)
Postoperative diversion (total)	7 (17.5)
External ventricular drain	4 (10.0)
Ventriculoperitoneal shunt	3 (7.5)
Histopathological diagnosis	
Vestibular schwannoma	15 (37.5)
Cerebellopontine angle meningioma	7 (17.5)
Metastasis	6 (15.0)
Medulloblastoma	3 (7.5)
Other histologies	9 (22.5)
WHO grade 1 tumors	29 (72.5)

CPA = cerebellopontine angle; WHO = World Health Organization. Mean tumor size did not differ significantly by extent of resection (P = 0.502).

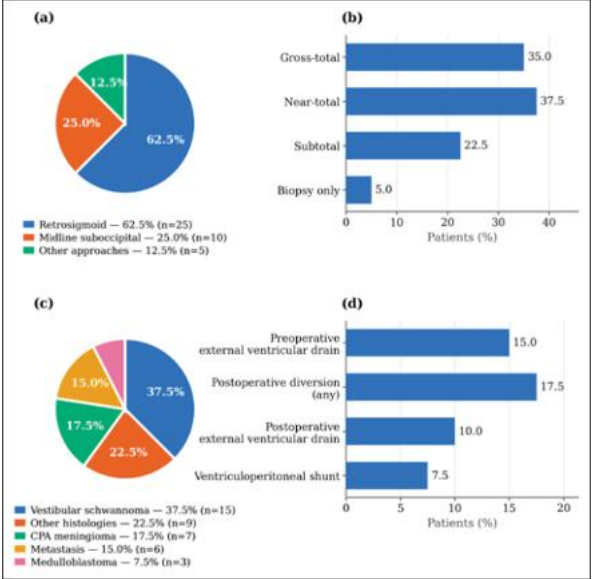


Figure 3: Surgical management and histopathological profile (n = 40). (a) Surgical approach. (b) Extent of resection. (c) Histopathological diagnosis. (d) Cerebrospinal fluid diversion requirements; the two drainage categories are components of postoperative diversion. CPA = cerebellopontine angle.

Vestibular schwannoma was the most frequent histopathological diagnosis (37.5%), followed by CPA meningioma (17.5%). World Health Organization (WHO) grade 1 tumors accounted for 72.5%. Six patients (15.0%) required preoperative external ventricular drainage, while seven (17.5%) required postoperative diversion (four external ventricular drains and three ventriculoperitoneal shunts). Hydrocephalus strongly predicted the need for CSF diversion (13/17 [76.5%] vs. 0/23; P<0.001).



Figure 4: Intraoperative photographs showing surgical excision of the

posterior fossa epidermoid tumor. (a) Intraoperative exposure following craniotomy, demonstrating the operative corridor to the posterior fossa lesion via a supracerebellar infratentorial approach. (b) Microsurgical view showing the characteristic pearly-white epidermoid tumor within the operative field during dissection. (c) Operative field following tumor excision and reconstruction/closure of the surgical defect.

Twenty-three patients (57.5%) experienced a postoperative complication; transient facial weakness was most frequent (20.0%), followed by CSF leak or pseudomeningocele (12.5%) and lower cranial-nerve palsy (10.0%). Complication frequency did not differ by extent of resection ($P=0.807$). At discharge, 29 patients (72.5%) had improved, six (15.0%) were unchanged, three (7.5%) deteriorated and two (5.0%) died. At three months, good recovery occurred in 10/23 patients with postoperative complications versus 14/17 without complications (43.5% vs. 82.4%; $P=0.013$) (Table 3, Figure 5).

Table 3: Early Outcomes and Principal Statistical Associations (n = 40)

Variable	Value
Outcome at discharge, n (%)	
Improved	29 (72.5)
Unchanged	6 (15.0)
Deteriorated	3 (7.5)
Died	2 (5.0)
Postoperative complications, n (%)	
Any complication	23 (57.5)
Transient facial weakness	8 (20.0)
CSF leak / pseudomeningocele	5 (12.5)
Lower cranial-nerve palsy	4 (10.0)
Principal associations	P value
Hydrocephalus and need for CSF diversion (13/17 [76.5%] vs. 0/23)	<0.001
Complications and good recovery at 3 months (43.5% vs. 82.4%)	0.013
Age across major tumor categories	0.002
Tumor size and extent of resection	0.502
Complication frequency and extent of resection	0.807
Tumor category and improvement at discharge	0.932
WHO grade 1 vs. malignant/metastatic, good recovery at 3 months (72.4% vs. 33.3%)	0.084

CSF = cerebrospinal fluid; WHO = World Health Organization.

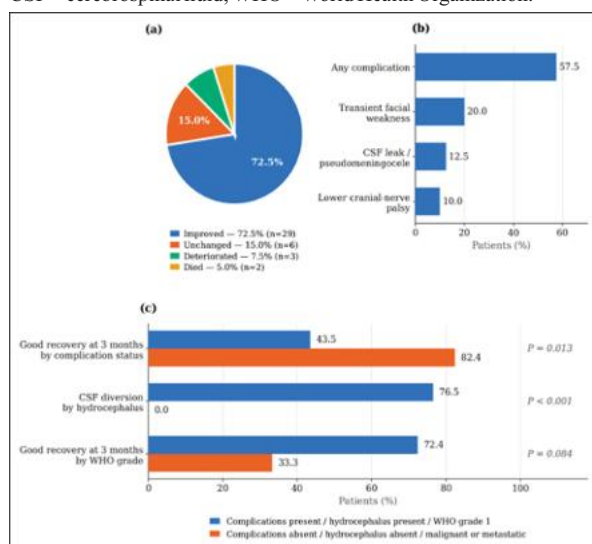


Figure 5: Early outcomes and principal statistical associations (n = 40). (a) Outcome at discharge. (b) Postoperative complications; categories are not mutually exclusive. (c) Paired comparisons of good recovery at three months by complication status and by WHO grade, and of cerebrospinal fluid diversion by the presence of hydrocephalus. P values from chi-square or Fisher exact tests. CSF = cerebrospinal fluid; WHO = World Health Organization.

Age differed significantly across major tumor categories ($P=0.002$): mean age was 46.0 years for CPA tumors and 53.2 years for metastases,

compared with 4.7 years for medulloblastoma and 1.8 years for ependymoma. Tumor category was not associated with discharge improvement ($P=0.932$), and the higher three-month good-recovery rate in WHO grade 1 tumors compared with malignant or metastatic tumors did not reach statistical significance (72.4% vs. 33.3%; $P=0.084$).

DISCUSSION

This prospective series demonstrates an adult-weighted, CPA-dominant spectrum of posterior fossa disease with substantial age-specific heterogeneity. The equal sex distribution and predominance of middle-aged adults are broadly consistent with recent mixed and adult surgical series, although the exact tumor spectrum varies by referral pattern.[3,4]

Clinical presentation tracked anatomical location. Auditory symptoms and imbalance were prominent because CPA tumors constituted more than half the cohort, whereas raised intracranial pressure and hydrocephalus were concentrated among midline and ventricular lesions. A large retrosigmoid series similarly reported frequent vertigo and hearing impairment in patients with CPA pathology.[7]

MRI showed close clinicoradiological-histopathological concordance, especially in CPA lesions. Contemporary studies confirm high diagnostic performance of MRI but also demonstrate that imaging can remain discrepant from final pathology, particularly in pediatric posterior fossa tumors; integration of imaging, operative findings and pathology remains essential.[5,6]

The retrosigmoid corridor was the workhorse approach in this cohort, reflecting the predominance of CPA lesions. Gross-total or near-total resection was achieved in 72.5%, similar to contemporary single-center reports. Importantly, tumor size alone was not associated with resection extent, supporting the practical observation that adherence to the brainstem, cranial nerves and vascular structures often limits radicality more than maximum diameter.[3,4,8]

Postoperative complications were common because the study captured minor and transient neurological events in addition to major morbidity. Their clinical relevance was evident: patients with complications had substantially lower good-recovery rates at both one and three months. This reinforces complication avoidance as a meaningful early-outcome target rather than viewing transient cranial-nerve deficits as inconsequential.

Hydrocephalus emerged as the clearest perioperative predictor. More than three-quarters of patients with hydrocephalus required CSF diversion, while none without hydrocephalus did. Larger adult series have similarly identified perioperative hydrocephalus, ventricular pathway involvement, hemorrhage, extent of resection and surgical complications as major determinants of temporary or permanent CSF diversion.[9,10]

Benign WHO grade 1 tumors showed a numerically better three-month outcome than malignant or metastatic lesions, although the difference was not statistically significant. This likely reflects limited subgroup power and short follow-up rather than absence of a biological effect. Pediatric studies likewise demonstrate strong outcome differences by tumor biology and completeness of resection over longer follow-up.[11-13]

Limitations

The study is limited by its small sample size, single-center referral pattern, heterogeneous adult-pediatric pathology and follow-up of only three months. Molecular classification was unavailable for relevant pediatric tumors, and formal validated functional or quality-of-life instruments were not used. These limitations constrain prognostic inference, but the prospective consecutive design provides a pragmatic snapshot of posterior fossa neurosurgical practice in a resource-constrained tertiary setting.[14]

CONCLUSION

Posterior fossa tumors showed pronounced age- and anatomy-dependent heterogeneity, with CPA tumors predominating in this adult-weighted cohort. MRI-guided planning and maximal safe resection achieved favorable short-term outcomes in most patients. Postoperative complications were associated with poorer early recovery, and hydrocephalus was the strongest determinant of CSF diversion. Larger multicenter studies with molecular characterization,

validated functional outcomes and longer follow-up are required to define independent prognostic factors.

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Conflict of Interest

None declared.

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