Original Article

OPEN ACCESS

Pakistan Journal of Healthcare Research

Comparative Surgical Outcomes of Schwannomas and Meningiomas in the Cerebellopontine Angle Using the Retrosigmoid Approach

Muneeb ur Rehman[1], Syed Saad Kakakhel[2], Ibrar Hussain[3], Ijaz Ul Haque[4]

[1-4]Department of Neurosurgery, Lady Reading Hospital Peshawar, KPK, Pakistan

ABSTRACT

Background: Cerebellopontine angle (CPA) tumors, predominantly Schwannomas and Meningiomas, pose significant surgical challenges due to their proximity to cranial nerves and critical neurovascular structures. While the retrosigmoid approach is commonly employed for CPA tumor excision, tissue-based differences in surgical outcomes have not been extensively studied.

Objective: To evaluate histopathology-specific differences in tumor characteristics, extent of resection, and postoperative cranial nerve outcomes following retrosigmoid surgery for CPA tumors.

Methods: The study was a retrospective observational study involving 102 patients who were retrosigmoid resected CPA tumor between 2021 and 2024 in the Department of Neurosurgery, Lady Reading Hospital Peshawar, KPK, Pakistan. Demographics of the patients, the tumor nature, extent of resection, and postoperative complications were taken into consideration. The comparison of Schwannomas and Meningiomas was carried out by means of Chi-square and Fisher tests. The statistical significance was set at $p = 0.05$.

Results: Of the cohort, 65 patients were found to have Schwannomas and 37 had Meningiomas. The total resection among Schwannomas and Meningiomas was gross in 89.2 and 100 percent respectively. There were no major differences in consistency or vascularity of the tumor. Facial nerve weakness was found in 20.0% of Schwannomas and in 5.4% of Meningiomas ($p = 0.011$) and loss of gag reflex in 18.5% of Schwannomas and none in Meningiomas ($p < 0.001$).

Conclusion: For patients with similar tumor characteristics and surgical resection, Schwannomas are linked with greater risks of postoperative cranial nerve deficits, in comparison to Meningiomas. These results demonstrate the significance of histopathology-specialized risk evaluation and intraoperative measures to save cranial nerve functions.

Keywords: Cerebellopontine angle; Schwannoma; Meningioma; Retrosigmoid approach; Cranial nerve outcomes

INTRODUCTION

A complex structure that is at the intersection of the cerebellum, pons, and medulla, the cerebellopontine angle (CPA) includes vital neurovascular formations, such as cranial nerves V-XII and anterior inferior cerebellar artery[1-3]. In adults the tumors in this area are commonly known as CPA space-occupying lesions (SOLs) and make up about 5 -10 percent of all intracranial neoplasms. The most common of these are vestibular Schwannomas and meningiomas, which are the second and third most common CPA tumor[4-7]. Both tumor types may result in hearing impairment, vertigo, thyroid facial nerve impairment, and lower cranial nerve impairment because of compression or infiltration and their surgical repair must be undertaken with utmost care to avoid undue neurovascular impact[8-10].

In the CPA, surgical excision is the primary mode of treatment of both Schwannomas and meningiomas, with the retrosigmoid approach being the most popular one because of its flexibility, reduced morbidity, and high reachability of the posterior fossa[11-13]. Although technologies have been developed, dural nerve injury, especially, facial nerve weakness in the postoperative period continues to be a serious issue, influencing the quality of life and functional independence of patients[14,15]. Such complication rates can vary according to tumor histopathology, natural growth patterns and their correlation with the neural structures associated with the tumor. The origins of Schwannoma are in the Schwann cells of cranial nerves, usually in the vestibulocochlear nerve, and accompanied by the possibility of a close attachment to the neighboring nerve, which raises the risk of postoperative morbidity[16-18]. Meningiomas, on the other hand, grow out of the dura, and are more likely to dislocate, than to penetrate neural tissue, allowing them to be safely excised without causing cranial nerve dysfunction[19-21].

Past research has generally been involved with surgical results of CPA tumors as one homogenous probably without stratifying the results on the basis of histopathology[22]. It is essential to gain insight into tissue-specific variations on tumor consistency, vascularity, resection extent, and postoperative morbidity to plan the operation, counsel the patient, and predict prognosis[23]. Besides, the ability to detect histopathology-specific risks can enable surgeons to plan intraoperative approaches, such as implementing intraoperative neurophysiological monitoring, cleaning up microsurgical dissection, and planning to limit cranial nerve injury. These personalized interventions are especially useful in difficult CPA lesions where maximum safe resection has to be determined as well as some functional preservation[24].

The lack of modern data on the comparison of Schwannomas and meningiomas in relation to the postoperative results in the retrosigmoid position is reported despite the identified clinical significance[25]. Available literature is mostly made up of case series or multicenter reports that use varied surgeries with the potential of not generalizing historically. Consequently, a specific analysis of sequential instances worked by a single surgical team will provide a peculiar chance to examine differences in tissues in a controlled and consistent operative setup.

This is the gap that the current study will address by comparing the nature of tumors and operative outcomes between Schwannomas and CPA meningiomas. In particular, we study the hypothesis of whether histopathology affects tumor consistency, vascularity, extent of resection, and postoperative cranial nerve impairment, such as facial nerve weakness and gag reflex loss. In an attempt to inform surgical decision-making, better risk classification, and better patient counseling, this paper aims to provide historically stratified data in histopathology and therefore improve patient outcomes in CPA tumor in terms of improved functional patient outcomes.

METHODOLOGY

It was a retrospective observational research at the Department of Neurosurgery, Lady Reading Hospital Peshawar, KPK, Pakistan. To identify histopathology-based variations in surgical outcomes of

Correspondence to: Syed Saad Kakakhel,
Department of Neurosurgery, Lady Reading Hospital, Peshawar, Pakistan.
Email: syedsaad23021998@gmail.com

How to Cite: Rehman M U, Kakakhel S S, Hussain I, Haque I U. Comparative Surgical Outcomes of Schwannomas and Meningiomas in the Cerebellopontine Angle Using the Retrosigmoid Approach. Pak. J. Healthc Res. 2025 Dec; 2(2): 1-4

Article History
Received: 12-10-2025 | Accepted: 08-12-2025 | Published: 30-12-2025

cerebellopontine angle (CPA) tumors. The reviewed medical records included consecutive patients who received surgical CPA space-occupying lesions excision with the retrosigmoid approach in the period between January 2021 and December 2024. The number of cases included in the study was restricted to those that were performed on by a single dedicated neurosurgical team in order to reduce procedural variability.

Patient demographics, tumor characteristics (size, consistency, and vascularity), extent of resection and postoperative complications (facial nerve weakness and other cranial nerve deficits) were data collected. Histopathological diagnosis was used to group tumors in Schwannoma and meningioma groups.

The Chi-square test was used to conduct comparisons across groups of categorical variables. Fisher exact test was used when the number of cells was below five as anticipated. The results of surgical operations were compared with the histopathology of tumors to investigate whether the specific tissue differences affected the morbidity of operations, the volume of resection, and the functional outcomes.

The analysis was conducted through a workflow of artificial intelligence-assisted analytical processing (ChatGPT, OpenAI) with direct oversight of the investigators to organize, tabulate, and calculate percentages and categorical comparative analysis. Each and every output was cross-validated to verify accuracy in its analysis and data integrity. The p-value of less than 0.05 was taken as capturing statistical significance.

RESULTS

One hundred and twenty-two cases of CPA tumors were identified and 65 tumors were Schwannomas with the remaining 37 tumors being Meningiomas. The Schwannoma group was dominated by males (56.9% or 37), with the mean age of 38.6 13.8 years, and Meningioma group was dominated by females (57.1% or 21) with the mean age of 40.1 13.5 years.

In Schwannomas, gross total resection (GTR) was done in 89.2 percent (58/65) and in Meningiomas in 100 percent (37/37). There were no important differences in tumor consistency (χ 2 (2) = 5.22, p = 0.072) or vascularity 2 (3) = 6.12, p = 0.105.

Nevertheless, the difference in postoperative complications was substantial. Facial nerve weakness was found in 20.0% (13/65) of Schwannoma patients versus 5.4% (2/37) in Meningioma patients 2 (1) = 6.45, p = 0.011; Fisher's exact but not corrected = 0.013). Likewise, gag reflex loss was observed in 18.5% (12/65) cases of Schwannoma but not at all (0/37) of Meningioma 2(1) = 13.05, p < 0.001; Fisher, exact p = 0.001).

These results suggest that although there was no difference in GTR and tumor features between Schwannomas and Meningiomas, Schwannomas had a higher probability to be connected with cranial nerve deficits after surgery.

Table 1: *Baseline Demographic Characteristics*

Variable	Schwannoma (n=65)	Meningioma (n=37)
Mean age (years)	38.6 ± 13.8	40.1 ± 13.5
Male sex	37 (56.9%)	16 (43.2%)
Female sex	28 (43.1%)	21 (57.1%)

Table 2: *Tumor Characteristics and Extent of Resection*

Characteristic	Schwannoma (n=65)	Meningioma (n=37)	p-value
Tumor consistency (soft/fibrous/mixed)	20/30/15	12/15/10	0.072
Tumor vascularity (low/moderate/high/very high)	18/25/15/7	10/12/10/5	0.105
Gross total resection	58 (89.2%)	37 (100%)	0.065
Subtotal resection	7 (10.8%)	0 (0%)	-

Figure: 1

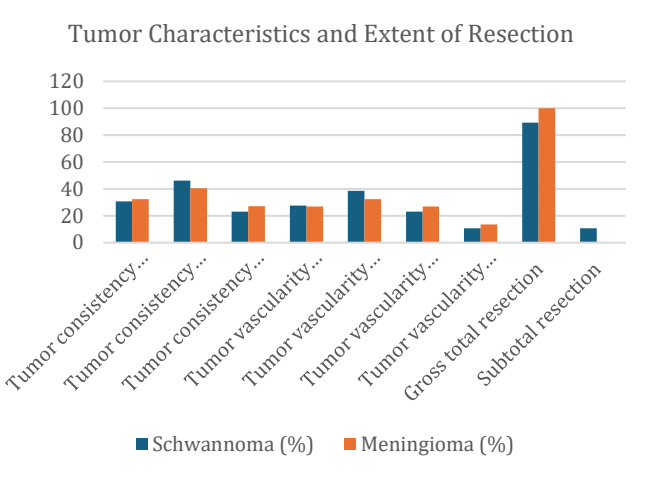
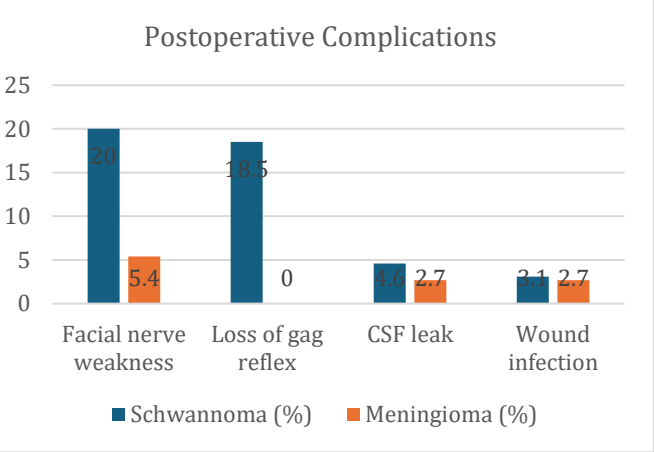


Table 3: *Postoperative Complications*

Complication	Schwannoma (n=65)	Meningioma (n=37)	p-value
Facial nerve weakness	13 (20.0%)	2 (5.4%)	0.011
Loss of gag reflex	12 (18.5%)	0 (0%)	<0.001
CSF leak	3 (4.6%)	1 (2.7%)	0.65
Wound infection	2 (3.1%)	1 (2.7%)	0.88

Figure: 2



Summary: While tumor consistency, vascularity, and extent of resection were similar for Schwannomas and Meningiomas, postoperative cranial nerve deficits, particularly facial nerve weakness and gag reflex loss, were significantly more common in Schwannoma cases.

DISCUSSION

Cerebellopontine angle (CPA) tumors are surgically challenging neoplasias that are typically Schwannomas and Meningiomas that are in the vicinity of cranial nerve and essential neurovascular areas. The current research demonstrated comparisons between the tumor characteristics and surgical outcomes of these two histopathologies through a retrosigmoid approach. Our results reveal that gross total resection (GTR) in most cases of Schwannomas and Meningiomas can be achieved, although, Schwannomas are linked with significantly high occurrence rates of postoperative cranial nerve defects, especially, facial nerve weakness and loss of gag reflex. This is consistent with the results of previous studies which have demonstrated higher morbidity of cranial nerves with schwannoma resection in that the tumor has an intrinsic origin of the vestibulocochlear nerve and that they have close associations with lower cranial nerves[22,23].

No statistically significant differences were shown in Schwannomas and Meningiomas in terms of tumor consistency,

vascularity or total extent of resection. These results imply that postoperative functional outcomes may be mainly due to inherent tumor biology and not the presence of gross anatomical or vascular features[23]. The schwannomas, which commonly appear due to the nerve sheath, can bring about manipulation or partial sacrifice of the cranial nerve fibers in seeking the maximum resection, which adds to the morbidity risk. Conversely, Meningiomas, which are dural based, tend to push neural structures along the line of excision, which is easier to excise and the reason why post-operative cranial nerve deficits are less prevalent[26].

We have important clinical implications. Although the goal of GTR is the target operation of both types of tumors, preoperative counseling about the risk of cranial nerve impairment is especially relevant to Schwannomas patients. Camouflaged microdissection, facial nerve monitoring, and neurophysiological guidance are intraoperative measures that can assist in the reduction of morbidity[22,26]. Moreover, our results emphasize the necessity to have histopathology-specific outcome expectations, which may be applied to both surgical planning and postoperative rehabilitation.

This study is confined by the retrospective and single-centre design and a small sample size. Moreover, the long-term functional outcomes and quality of life indices were not systematically evaluated, which have the potential to give more insight into the actual implication of cranial nerve deficits in real-life. Although such limitations are present, the research provides some excellent comparative insights into tissue-specific risk of CPA tumor surgery that supports the significance of individual approach to surgical procedures[23,26].

Finally, CPA Schwannomas are associated with a more significant risk of any cranial nerve postoperative deficit than Meningioma, even with comparable tumor consistency, vascularity, and resection levels. It is imperative that these histopathology driven differences be identified to allow surgical planning, risk stratification, and patient counseling to ensure maximum safe resection is obtained with minimum functional morbidity[22,23,26].

CONCLUSION

This paper has shown that histopathology has important effects on postoperative outcomes in CPA tumors. Although the gross total resection rates and tumor features (consistency and vascularity) were similar in Schwannomas and Meningiomas, Schwannomas were climaxed with a higher fraction of facial nerve weakness and gag reflex loss. The differences are probably because of the inherent origin of Schwannomas of cranial nerves resulting in susceptibility to more nerve damage during the resection process. By contrast, meningiomas are more likely to push away, but not to invade neural structures, which leads to lower morbidity. All these findings underline the necessity of surgical planning by means of histopathology, counseling of patients, and intraoperative neurophysiological monitoring to reduce cranial nerve injuries. The need to use long-term functional and quality-of-life outcomes of future prospective studies is justified to fine-tune surgical interventions and provide patients with better patient-centered care in CPA tumors.

Authors' Contribution

MUR, SSK: Concept & study design, data collection and drafting of the manuscript.
IH: Data entry, statistical analysis, interpretation of the results.
IUH: Manuscript editing and critical revision of the manuscript.
All authors approved the final version of the manuscript to be published.

Conflict of Interest

The authors declared no conflict of interest.

Funding

No funding was received by the authors.

Data Availability

Data is available with authors and can be provided on request.

REFERENCES

1. Dekker, S. E., et al. (2023). Vascular Lesions of the Cerebellopontine Angle. Surgery of the Cerebellopontine Angle, Springer: 283-299. https://doi.org/10.1007/978-3-031-12507-2_21
2. Rahimpour, S., et al. (2023). Approaches to the Cerebellopontine Angle. Surgery of the Cerebellopontine Angle, Springer: 61-70. https://doi.org/10.1007/978-3-031-12507-2_5
3. Błaszczyk, M., et al. (2024). "The arterial anatomy of the Cerebellum—A comprehensive review." Brain Sciences 14(8): 763. https://doi.org/10.3390/brainsci14080763
4. Saigal, G., et al. (2021). "Utility of microhemorrhage as a diagnostic tool in distinguishing vestibular schwannomas from other cerebellopontine angle (CPA) tumors." Indian Journal of Otolaryngology and Head & Neck Surgery 73(3): 321-326. https://doi.org/10.1007/s12070-021-02372-8
5. Xue, Y.-T., et al. (2021). "Comorbidity of cerebellopontine angle meningioma with other primary neoplasms." Acta Oto-Laryngologica 141(1): 57-61. https://doi.org/10.1080/00016489.2020.1826575
6. Mkrtchyan, N., et al. (2022). "Hearing recovery after surgical resection of non-vestibular schwannoma cerebellopontine angle tumors." European Archives of Oto-Rhino-Laryngology 279(5): 2373-2382. https://doi.org/10.1007/s00405-021-06956-6
7. Yuan, L., et al. (2025). "The classification of vestibular Schwannoma (VS) and cerebellopontine angle meningioma (CPAM) based on multimodal magnetic resonance imaging analysis." Diagnostics 15(9): 1157. https://doi.org/10.3390/diagnostics15091157
8. Fahmy, A. and A. Mahmood (2021). "Vestibular schwannoma causing unilateral facial pain in 20-year-old patient." Ear, Nose & Throat Journal 100(5_suppl): 753S-754S. https://doi.org/10.1177/0145561320908479
9. Darrouzet, V., et al. (2024). Microsurgery of Cerebellopontine Angle Tumors. Neurotology Updates, Springer: 757-785. https://doi.org/10.1007/978-3-031-77370-9_37
10. Radparvar, S. (2025). "Vestibular schwannoma: evolution of diagnosis and treatment." Egyptian Journal of Neurosurgery 40(1): 5. https://doi.org/10.1186/s41984-025-00349-1
11. Ramina, R., et al. (2023). Surgical Anatomy of Cerebellopontine Cistern. Brain Anatomy and Neurosurgical Approaches: A Practical, Illustrated, Easy-to-Use Guide, Springer: 275-301. https://doi.org/10.1007/978-3-031-14820-0_14
12. Zhang, H., et al. (2023). "Fully neuroendoscopic resection of cerebellopontine angle tumors through a retrosigmoid approach: a retrospective single-center study." Neurosurgical Review 47(1): 14. https://doi.org/10.1007/s10143-023-02244-5
13. Kanaan, I. N. (2024). Retrosigmoid Approach and Hybrid Use of Endoscopy in CPA Tumors. Neuroanatomy Guidance to Successful Neurosurgical Interventions: The Torch of Neurosurgical Excellence, Springer: 487-497. https://doi.org/10.1007/978-3-031-59838-8_45
14. Fernández-Conejero, I., et al. (2022). "Monitoring cerebellopontine angle and skull base surgeries." Handbook of Clinical Neurology 186: 163-176. https://doi.org/10.1016/b978-0-12-819826-1.00016-8
15. Jethanamest, D. and J. Thomas Roland Jr (2023). Complications and Cranial Nerve Rehabilitation. Surgery of the Cerebellopontine Angle, Springer: 197-206. https://doi.org/10.1007/978-3-031-12507-2_15
16. Palmisciano, P., et al. (2022). "Surgical management of craniovertebral junction schwannomas: a systematic review." Current Oncology 29(7): 4842-4855. https://doi.org/10.3390/curroncol29070384
17. Corrêa, D. G., et al. (2023). The vestibulocochlear nerve: anatomy and pathology. Seminars in Ultrasound, CT and MRI, Elsevier. https://doi.org/10.1053/j.sult.2023.03.007
18. Mohamed, T., et al. (2023). "Hearing loss and vestibular schwannoma: new insights into Schwann cells implication." Cell Death & Disease 14(9): 629. https://doi.org/10.1038/s41419-023-06141-z

19. Bailo, M., et al. (2023). Meningioma and other meningeal tumors. Human Brain and Spinal Cord Tumors: From Bench to Bedside. Volume 2: The Path to Bedside Management, Springer: 73-97. https://doi.org/10.1007/978-3-031-23705-8_3
20. Westphal, M., et al. (2023). Skull base meningiomas. Biological and clinical landscape of meningiomas, Springer: 47-68. https://doi.org/10.1007/978-3-031-29750-2_5
21. Ungureanu, G., et al. (2025). "Optimizing Surgical Management of Anterior Skull Base Meningiomas: Imaging Modalities, Key Surgical Considerations, and Risk Mitigation Strategies." Cancers 17(6): 987. https://doi.org/10.3390/cancers17060987
22. Verma RP, Yadav A, Kumar V, Ojha BK, Chandra A, Verma R. Surgical Outcomes and Predictive Factor Analysis for Facial Nerve Preservation in Patients with Cerebellopontine Angle (CPA) Tumors: A Ten-Year Single Institutional Study. Cureus. 2024 Jun 5;16(6):e61756. PMID: 38975511; PMCID: PMC11226413. https://doi.org/10.7759/cureus.61756.
23. De Marco, R., Morana, G., Sgambetterra, S., Penner, F., Melcarne, A., Garbossa, D., Lanotte, M., Albera, R., & Zenga, F. (2025). Predicting the Consistency of Vestibular Schwannoma and Its Implication in the Retrosigmoid Approach: A Single-Center Analysis. Current Oncology, 32(11), 647. https://doi.org/10.3390/curroncol32110647
24. Aftahy, A. K., Goldberg, M., Butenschoen, V. M., Wagner, A., Meyer, B., & Negwer, C. (2024). Functional outcomes after retrosigmoid approach to the cerebellopontine angle: Observations from a single-center experience of over 13 years. Brain and Spine, 4, 102909. https://doi.org/10.1016/j.bas.2024.102909
25. Alomari, A. A., et al. (2024). "Optimizing retrosigmoid approach for giant vestibular schwannoma resection: strategies and advances in surgical technique." AME Surgical Journal 4. https://doi.org/10.21037/asj-24-3
26. Aguiar PH, Tahara A, Almeida AN, Simm R, Silva AN, Maldaun MV, Panagopoulos AT, Zicarelli CA, Silva PG. Olfactory groove meningiomas: approaches and complications. J Clin Neurosci. 2009;16(9):1168–1173. https://doi.org/10.1016/j.jocn.2008.12.013.