A Retrospective Clinicoradiologic Study of 126 Cerebellopontine Angle Tumors to Predict the Outcome of House–Brackmann Status to Prognosticate Them: A Single-Center Tertiary Care Perspective

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Abstract

Introduction House–Brackmann (HB) grading had been described to quantify the facial nerve involvement in cerebellopontine angle (CPA) tumors, a very common tumor in neurosurgical practice. Very few studies have specifically looked into the factors predicting the facial nerve morbidity and its severity. Here, we try finding these while going through the clinicoradiologic factors and its natural course to help us prognosticate the patients.

Objective To analyze the size of tumor and duration of symptoms to predict the severity of HB status of facial nerve presentation and outcome, and to study the course of the disease to help prognosticate the patients with respect to facial nerve status.

Materials and Methods This was a retrospective analysis of 126 operated CPA tumors, where we studied the natural course of HB status with respect to size and duration of symptoms of patients at our institute between December 2016 to February 2020.

Results Average duration of symptoms were 33.8 days with increasing risk of HB outcome after 36 days of symptoms. All patients improved to their preoperative facial nerve status at 3 months and only 18 maintained the worsened HB status. Average size of tumor was 3.53 cm, and size higher than 3.8 cm was associated with poorer HB outcome.

Conclusion Although there can be a significant deterioration of HB status in immediate postoperative period, it improves to preoperative status in due time. Tumor larger than 3.8 cm and symptom duration more than 36 days are two important factors predicting poorer HB outcome.

Keywords

- cerebellopontine angle tumor
- House–Brackmann grading
- symptom duration

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Introduction

We frequently encounter intracranial neoplasm in our neurosurgical practice, and one of the common tumors which frequently manifest itself clinically is cerebellopontine angle (CPA) tumors with various symptoms.¹ They can either present with symptoms of hydrocephalus or symptoms of cranial nerve involvement (most commonly vestibulocochlear nerve).^{2,3} Pathologies commonly seen at the CPA are vestibular schwannoma, meningioma, and epidermoid⁴ in decreasing order of incidence. Other lesions in these areas can be infective causes and other rare cases.⁴⁻⁷ Approaches are mainly retromastoid suboccipital (RMSO), translabyrinthine,⁸ or through middle fossa.⁹

Acoustic neuromas, also known as vestibular schwannomas, account for approximately 6% of all brain tumors. Vestibular schwannoma, being the most common encountered in this area, presents most commonly with unilateral sensorineural hearing loss and other cranial nerve pathologies, and facial nerve involvement has been one of the most common causes of morbidity in these patients. House-Brackmann (HB)¹⁰ grading had been described to quantify the facial nerve involvement. Various staging and grading by various researchers tried to look into size of the tumors in predicting the clinical outcome¹¹⁻¹⁴ including Koos grading.⁹ Very rarely had anyone specifically looked into the factors predicting facial nerve morbidity and its severity.

Here, in this study, we evaluated 126 of our patients operated in a single tertiary care institution and tried to compare preoperative symptoms with postoperative clinical and histopathological outcomes along with the specific target of looking into the size and duration of symptoms predicting the facial nerve HB status and the critical value above which risk and morbidity increases. We also aimed to observe the course of facial nerve HB status during the course of symptoms to help prognosticate the patients pre- and postoperatively.

Aims

1. To analyze the size of tumor and duration of symptoms to predict the severity of HB status of facial nerve presentation and outcome.
2. To study the course of the disease to help prognosticate the patients with respect to facial nerve status.

Materials and Methods

This retrospective study was conducted in the Department of Neurosurgery, Institute of Medical Sciences–Banaras Hindu University, Varanasi, between December 2016 to February 2020 and included 126 cases of CPA tumor who underwent surgical removal with the help of the RMSO approach. It included patients of all age groups and sex presenting in our hospital. All the patients were admitted after clinical assessment under a standard medical protocol and subjected to basic hematochemical and radioimaging evaluation. Patients were selected for surgery after considering several factors

including age, tumor size, duration of symptoms, preoperative hearing (ipsilateral as well as contralateral), patient's general condition, and patient expectations. The different treatment options like no intervention, radiotherapy, or surgery were discussed with the patients.

A RMSO approach was used for all the tumors. Unserviceable tumors, defined as speech reception threshold (SRT) more than 50 dB and speech discrimination score (SDS) less than 50%, were excluded from the study.

Facial nerve status was measured by HB grading in preoperative period and postoperative periods—immediate, 2-, and 3-month intervals.

The data was compiled and analyzed. Statistical analysis was done by Chi-square, logistic regression, and students *t*-test wherever applicable using SPSS software.

Results

In our study, we had total 126 patients, of which 52.4% (66/126) were female and 47.6% (60/126) were males (►Table 1). As much as 85.7% patients (108/126) underwent only excision, and the remaining 18 patients required shunting before definitive surgery because of hydrocephalus (►Table 1). All patients had full Glasgow coma scale (GCS) score at admission. Postoperatively, 48 patients had a deterioration of GCS due to postoperative edema which improved over the following days. Preoperatively, 9.5% (12/126) patients had normal facial nerve condition clinically, and majority had a HB of 3 before surgery (71.4%) (►Table 1). Immediately after surgery, 42 patients had a poorer HB status than their preoperative condition, while others had the same facial nerve status in the immediate postoperative period. Among the above 42 patients, 24 patients improved to their preoperative facial nerve status and the remaining 18 maintained the worsened HB status after 3 months. None of the patients had a better HB status compared with the preoperative status (►Table 1). Around 9.5% patients had preoperative tinnitus (12/126) and 81% (102/126) had preoperative vertigo. Only 12 patients had 5th nerve involvement, and lower cranial nerve involvement was also seen in 9.5% patients (►Table 1). Fifth nerve status remained same after surgery for all the 12 patients.

The average size of tumor was 3.53 cm, and those patients with tumor size greater than 3.8 cm were significantly associated with poorer HB status at presentation and final HB outcome at 3 months of the patient (►Table 2). Average duration of symptoms were 33.8 days. Patients with longer duration of presentation had a poorer HB status at presentation and outcome, and it is significant after an average of 36 days of duration of symptoms (►Table 2). In the biopsy report, 80.9% had schwannoma as the most common finding with Verocay bodies and Antoni A features (►Fig. 1A, B). Other histological findings are shown in ►Fig. 1. Six patients had meningioma, six had ependymoma, and 12 had epidermoid. Total excision was possible for epidermoid and ependymoma cases. Sixty schwannoma patients underwent total excision; for the rest of the 42 patients, there were some residual tumors, and they were referred for gamma radiation therapy. Due to profuse

Table 1 Summary of patient characteristics and outcome

Variable	Subparameter	No. of patients (%)
Size	< 3 cm	36 (28.6)
	3–3.9 cm	54 (42.8)
	≥ 4 cm	36 (28.6)
Gender	Male	60 (47.6)
	Female	66 (52.4)
Surgery	Excision only	108 (85.7)
	Shunt + excision	18 (14.3)
Preoperative GCS	15	126 (100)
	< 15	0 (0)
Postoperative GCS	15	78 (61.9)
	< 15	48 (38.1)
HB before surgery	1	12 (9.5)
	2	24 (19)
	3	90 (71.4)
	4	0 (0)
HB immediately after surgery	1	12 (9.5)
	2	6 (4.8)
	3	78 (61.9)
	4	30 (23.8)
HB 2 mo after surgery	1	12 (9.5)
	2	12 (9.5)
	3	72 (57.1)
	4	30 (23.8)
HB 3 mo after Surgery	1	12 (9.5)
	2	18 (14.3)
	3	90 (71.4)
	4	6 (4.8)
Vertigo	Yes	102 (81)
	No	24 (19)
Tinnitus	Yes	12 (9.5)
	No	114 (90.5)
Cranial nerve 7	Yes	114 (90.5)
	No	12 (9.5)
Cranial nerve 5	Yes	12 (9.5)
	No	114 (90.5)
Lower cranial nerves	Yes	12 (9.5)
	No	114 (90.5)
Biopsy	Schwannoma	102 (81)
	Meningioma	6 (4.8)
	Ependymoma	6 (4.8)
	Epidermoid	12 (9.5)

Abbreviations: HB, House–Brackmann; GCS, Glasgow coma scale.

intraoperative bleeding, three (50%) meningiomas could not be excised totally and were planned for second look surgery on follow-up. There were two cases of postoperative wound infection, which was managed successfully with the use of

antibiotics. There was no incidence of cerebrospinal fluid (CSF) leak or death in our study population.

► **Figs. 2, 3 and 4**, show preoperative CT scan. ► **Fig. 5** shows intraoperative findings and ► **Fig. 6** shows postoperative radiological findings.

Discussion

In our study, we operated all our patients through the RMSO approach.¹⁵ In cases with no hearing preservation or non-serviceable hearing, we preferred the translabyrinthine approach,⁸ and when tumors had significant lateral extension, we opted for the middle fossa approach.¹ All patients were positioned laterally for the RMSO approach as shown in ► **Fig. 5C**; however, the study by Velho et al described the semisitting position in the suboccipital approach as helping in quick exposure of the tumor.¹⁶ Safdarian et al described the sitting position for the patients but did not find any advantage in relation to the position when compared with the RMSO approach.¹⁷ In our study, 85.7% patients underwent only excision, and the remaining 14.3% patients required shunting before definitive excision, because of hydrocephalus.¹⁸ Preoperatively, 9.5% patients had normal facial nerve condition clinically, and the majority had a HB of 3 before surgery (71.4%). Facial nerve involvement was found to be much lower in other studies.¹⁹ There were several causes for more patients' (90.5%) involvement of facial nerve. We had taken only patients who underwent surgery in our center and not all outdoor patients. Most patients were presenting late when there was hearing loss or involvement of facial nerve. We had also selected all patients of CPA tumor and not just acoustic neuromas.

Immediately after surgery, seven patients had a poorer HB status probably because of edema and intraoperative dissection.¹⁰ Similarly, in a study by Ling Chen et al¹⁵ which included 145 patients, 115 patients had functional preservation for facial nerve (79.3%). Long-term follow-up at 3 months showed all patients improved to their preoperative facial nerve status except three patients who had maintained the worsened HB status after 3 months. In our study, 42 patients had postoperative deterioration of HB status, 24 patients improved to their preoperative facial nerve status, and the remaining 18 had maintained the worsened HB status after 3 months in our population. None of the patients had an HB status better than the preoperative status, a finding which probably indicates that nerves get damaged significantly and irreversibly in preoperative period because of late presentation. The average duration of symptoms in our study was 33.8 days. We could not find any previous study about the relation of delayed presentation and poor outcome. Our study may be the first one to identify this. A significant number of patients improving back to preoperative HB status shows, postoperatively, patients should be prognosticated positively for expecting improvement in the coming days.

In our study, greater than 3.8 cm tumors were significantly associated with poorer HB status of the patient, which is similar to the findings of Wu et al.²⁰ Rinaldi et al concluded

Table 2 Facial nerve HB status

At presentation		HB 1–2 (n = 36)	HB 3–4 (n = 90)	p-Value
	Size (cm)	2.77 ± 0.27	3.84 ± 0.38	< 0.001
	Duration (mo)	25.67 ± 3.73	37.07 ± 3.40	< 0.001
Final outcome at 3 mo		HB 1–2 (n = 30)	HB 3–4 (n = 96)	p-Value
	Size (cm)	2.94 ± 0.52	3.72 ± 0.50	< 0.001
	Duration (mo)	29.40 ± 5.21	35.19 ± 6.24	< 0.001

Abbreviation: HB, House–Brackmann.

Note: Data given as mean ± SD.

Fig. 1 Histological findings. (A) Verocay body. (B) Antoni A. (C) Degenerated cells. (D) Meningioma. (E) Psammomatous bodies. **Fig. 2** Preoperative CT scan findings of epidermoid ((A) axial/[B] coronal/[C] sagittal view). **Fig. 3** Preoperative CT scan findings of meningioma ((A) axial/[B] coronal/[C] sagittal view). **Fig. 4** Preoperative CT scan findings of schwannoma ((A) axial/[B] coronal/[C] sagittal view).

Fig. 5 Intraoperative findings ([A] Cavitron ultrasonic surgical aspirator being used for intratumoral resection, [B/D/E/F] during intraoperative dissection, [C] Right lateral position retromastoid suboccipital approach for left cerebellopontine angle tumor surgery).

Fig. 6 Postoperative CT scan findings ([A] axial/[B] coronal/[C] sagittal view).

that with the use of simultaneous intraoperative electromyography (EMG) and pneumatic facial nerve monitoring, a significant improvement of the short-term facial nerve outcome is detected.²¹ In our study, we used intraoperative neuromonitoring for all patients which helped in a better functional outcome. Of the total 62 patients with preoperative normal facial nerve function (HB grade I) in their study, 24 (38.7%) reported immediate postoperative facial nerve deficit, which is a little less compared with our study findings of 33.3%. Subsequently, they underwent intravenous corticosteroid treatment which was done in our cases also, who had a worse HB outcome after surgery compared with preoperative status. However, most of them improved at 3 months.

None of the patients had a better HB status compared with the preoperative status. Around 9.5% patients had preoperative tinnitus and 81% had preoperative vertigo. Most patients had facial nerve involvement preoperatively and only 9.5% patients had 5th nerve involvement. Fifth nerve

status remained same after surgery in these patients. In the biopsy report, 80.9% had schwannoma²² as the most common finding with Verocay bodies and Antony A features (►Fig. 1A). Sarrazin et al in their study²³ concluded that vestibular schwannoma was the most common lesion, which is consistent with our study. Meningioma was the second most common tumor.

Total excision was possible for epidermoid and ependymoma. Sixty schwannoma patients underwent total excision, which was less compared with some European studies, and could be based on some studies done on morphometric characteristics and because of less space and more adhesions in Indian population.²⁴ Some residual tumors were referred for gamma radiation therapy. In a study by Iwai et al, tumor size reduced in six patients among the 14 patients with excellent facial nerve preservation.²⁵ In their study, they concluded that incomplete excision was an important indication for radiotherapy. Due to profuse intraoperative bleeding, meningioma

could not be excised totally and was planned for second look surgery on follow-up in our study. None of our patients had a CSF leak postoperatively, and in all the patients, a watertight dural closure was done, an outcome better than many series. Celikkanat et al showed in their study that there were 6.2% CSF leak.²⁶ It was probably because the RMSO approach has lesser risk of CSF leak compared with other approaches. Gender or age had no correlation with the outcomes. Although there was significant deterioration immediately after surgery in HB status, but there was no statistically significant difference in facial nerve status between the preoperative and postoperative states ($p < 0.001$) at 3 months.

Conclusion

In our study, majority (85.7%) did not have a worse HB outcome following surgery. It shows that through a meticulous surgery with routine neuromonitoring, we should be able to preserve facial nerve functionally. Although there can be a significant deterioration in the immediate postoperative period, it improves to preoperative status in due time. This finding can help us to prognosticate the patients in a positive way preoperatively as well as postoperatively for expecting an improvement over the coming days to alleviate their anxiety, which comes with immediate postoperative deterioration, although there may not be an overall improvement compared with preoperative status. Large tumor at presentation more than 3.8 cm and a symptom duration more than 36 days has a poorer HB status at presentation and final outcome, and these are two important poor prognostic factors.

Conflict of Interest

None declared.

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