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Analysis of 55 Adult Cases Surgically Treated for Pontocerebellar Angle Tumors

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Abstract

Objective: Pontocerebellar angle (PCA) tumors, although typically of benign nature, are of significant clinical and pathological importance. The aim of this study is to investigate the clinical and pathological characteristics of PCA tumors, as well as surgical outcomes, which hold a significant place in clinical practice.

Methods: 55 adult patients who underwent surgery for PCA tumors at the Department of Neurosurgery, Dicle University Faculty of Medicine, between 2013 and 2023 were included in the study. The clinical and pathological records of these patients were retrospectively reviewed.

Results: The age of the patients (17 male, 38 female) ranged from 18 to 75 years. According to pathological diagnosis, 23 cases were diagnosed as meningioma, 19 as schwannoma, 6 as epidermoid tumors, 2 as metastases, 1 as hemangioblastoma, 1 as hemangioma, 1 as medulloblastoma, 1 as neuroblastoma, and 1 as small round cell tumor. Gross total resection was achieved in all cases. Overall, 47.3% of the patients had one or more postoperative complications. Postoperative permanent facial palsy developed in 6 patients. The overall mortality rate was 9%.

Conclusion: PCA tumors constitute a significant group among intracranial tumors. Surgical treatment is an important option for the management of these tumors. Primary goal of the surgery is gross total resection which is feasible in today. Though postoperative complications are common, majority of them is temporary.

Keywords: Pontocerebellar, Tumor, Neoplasm, Surgery, Complication

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INTRODUCTION

The pontocerebellar angle (PCA) is defined as the subarachnoid space between the ventral surface of the brainstem and the medial cerebellar hemisphere. It is limited laterally by the superior and inferior limbs of the cerebellopontine fissure (1).

The first successful surgery for tumors located in the PCA was performed by Charles Ballance in 1894 (2). In 1925, Dandy demonstrated the total resection of vestibular schwannomas with acceptable morbidity and mortality rates (3). With advancements in surgical microscopy and microsurgical techniques, the mortality and morbidity rates have further decreased (3, 4).

In the region of the PCA, various tumors can arise from neuroglial tissues, cranial nerve sheaths, meninges, and embryonic remnants (5). Among adults, the majority of these tumors are vestibular schwannomas, followed by meningiomas and epidermoid tumors (6, 7).

Although PCA tumors are generally benign, they present unique challenges and complications due to the involvement of cranial nerves. Possible surgical complications include facial and cochlear nerve damage, cerebrospinal fluid (CSF) leakage, ischemic or hemorrhagic vascular injuries, hydrocephalus, and headache (8).

In this study, we aimed to examine the symptoms, clinical, radiological, and pathological characteristics, as well as surgical complications related to the surgically treated PCA tumors in our department.

METHODS

This retrospective study was approved by Dicle University Medical Faculty Committee for Noninterventional Studies (Date: 17.01.2023, No: 38). The patients that were operated for PCA tumors at Dicle University Department of Neurosurgery, between January 2013 and December 2022 were included in this study.

The patients that were surgically treated for PCA tumors were identified by searching hospital patient archives and radiology database and age, gender, clinical presentation, radiological findings, extent of resection, pathological classification, and complications were recorded.

RESULTS

The mean age of the 55 patients included in this study was 45.38 ± 13.74, with a female to male ratio of 2.23 (Table 1).

The most commonly identified tumors were meningiomas (41.8%), schwannomas (34.5%), and epidermoid tumors (10.9%). In two patients

(3.6%), the tumor pathology was determined as metastasis (squamous cell carcinoma and pleomorphic breast carcinoma). All histopathological types are summarized in Table 2.

Table 1. Demographical and clinical data of 55 patients included in the study

Age (years)		
	Mean ± SD	45.38 ± 13.74
	Median (Minimum – Maximum)	45 (18 – 75)
Gender		
	Female, n (%)	38 (69.1)
	Male, n (%)	17 (30.9)
Symptoms		
	Pain, n (%)	37 (67.3)
	Vertigo, n (%)	10 (18.2)
	Hearing loss, n (%)	9 (16.4)
	Imbalance, n (%)	5 (9.1)
	Tinnitus, n (%)	5 (9.1)
	Facial asymmetry, n (%)	3 (5.5)
	Nausea vomiting, n (%)	1 (1.8)
	Double vision, n (%)	1 (1.8)
	Hoarseness, n (%)	1 (1.8)
	Dysphagia, n (%)	1 (1.8)
	Memory impairment, n (%)	1 (1.8)
	Incidental, n (%)	1 (1.8)
Signs		
	Hearing loss, n (%)	16 (29.1)
	Facial palsy, n (%)	5 (9.1)
	Diplopia, n (%)	1 (1.8)
	Hoarseness, n (%)	1 (1.8)
	Visual loss, n (%)	1 (1.8)
	Dysmetria, n (%)	1 (1.8)
	Dysdiakokinesia, n (%)	1 (1.8)
	Normal, n (%)	34 (61.8)
Side		
	Right, n (%)	29 (52.7)
	Left, n (%)	25 (45.5)
	Bilateral, n (%)	1 (1.8)
Diameter (mm)		
	Mean ± SD	33.60 ± 10.62
	Median (Minimum – Maximum)	35 (8 – 52)

SD: standard deviation

Overall, the most common presenting symptom in the population was pain (67.3%), followed by vertigo and hearing loss (18.2% and 16.4% respectively) (Table 2). When looking at specific tumor types, the most common presenting complaints in

Table 2. Surgical data of the population

Resection			
	Gross total resection, n (%)		55 (100)
Pathology			
	Meningioma, n (%)		23 (41.8)
	Schwannoma, n (%)		19 (34.5)
	Epidermoid tümor, n (%)		6 (10.9)
	Metastasis, n (%)		2 (3,6)
	Hemangioblastoma, n (%)		1 (1.8)
	Hemangioma, n (%)		1 (1.8)
	Medulloblastoma, n (%)		1 (1.8)
	Neurofibroma, n (%)		1 (1.8)
	Small round cell tumor, n (%)		1 (1.8)
Postoperative complication, n (%)			26 (47.3)
	Facial palsy, n (%)		14 (25.4)
		Temporary, n (%)	8 (14.5)
		Permanent, n (%)	6 (10.9)
	Dysphagia, n (%)		3 (5.5)
		Temporary, n (%)	3 (5.5)
		Permanent, n (%)	0 (0.0)
	CNS infection, n (%)		7 (12.7)
	CSF fistula, n (%)		5 (9.1)
	Pneumonia, n (%)		5 (9.1)
	Wound infection, n (%)		1 (1.8)
	Pulmonary embolism, n (%)		1 (1.8)
	SVT, n (%)		1 (1.8)
	DVT, n (%)		1 (1.8)
Follow up (months)			
	Mean ± SD		19.49 ± 21.61
	Median (Minimum –Maximum)		10 (0.5 – 72)
Outcome			
	Better, n (%)		8 (14.5)
	No change, n (%)		36 (65.5)
		Deficit -, n (%)	29 (52.7)
		Deficit +, n (%)	7 (12.7)
	Worse, n (%)		6 (10.9)
	Exitus, n (%)		5 (9.1)

SD: standard deviation, CNS: central nervous system, CSF: cerebrospinal fluid, SVT: sinus venous trombosis, DVT: deep vein thrombosis

Table 3. Symptoms, signs, and complications of most common PCA tumor

		Meningioma (n=23)	Schwannoma (n=19)	Epidermoid tümor (n=6)
Symptoms				
	Pain, n (%)	19 (82.6)	11 (57.9)	4 (66.7)
	Vertigo, n (%)	7 (30.4)	3 (15.8)	0 (0.0)
	Hearing loss, n (%)	1 (4.3)	7 (36.8)	0 (0.0)
	Imbalance, n (%)	1 (4.3)	1 (5.3)	1 (16.7)
	Tinnitus, n (%)	0 (0.0)	4 (21.0)	0 (0.0)
	Facial asymmetry, n (%)	1 (4.3)	1 (5.3)	1 (16.7)
	Nausea vomiting, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Double vision, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Hoarseness, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Dysphagia, n (%)	0 (0.0)	0 (0.0)	1 (16.7)
	Memory impairment, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
Signs				
	Hearing loss, n (%)	3 (13.0)	12 (63.1)	0 (0.0)
	Facial palsy, n (%)	2 (8.7)	2 (10.5)	1 (16.7)
	Diplopia, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Hoarseness, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Visual loss, n (%)	0 (0.0)	0 (0.0)	1 (16.7)
	Dysmetria, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	Dysdiakokinesia, n (%)	0 (0.0)	1 (5.3)	0 (0.0)
	Normal, n (%)	18 (78.3)	6 (31.6)	4 (66.7)
Postoperative complication, n (%)		9 (39.1)	13 (68.4)	2 (33.3)
	Facial palsy, n (%)			
	Temporary, n (%)	0 (0.0)	8 (42.1)	0 (0.0)
	Permanent, n (%)	1 (4.3)	5 (26.3)	0 (0.0)
	Dysphagia, n (%)			
	Temporary, n (%)	2 (8.7)	1 (5.3)	0 (0.0)
	CNS infection, n (%)	3 (13.0)	1 (5.3)	1 (16.7)
	CSF fistula, n (%)	2 (8.7)	2 (10.5)	1 (16.7)
	Pneumonia, n (%)	1 (4.3)	2 (10.5)	1 (16.7)
	Wound infection, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
	SVT, n (%)	0 (0.0)	1 (5.3)	0 (0.0)
	DVT, n (%)	1 (4.3)	0 (0.0)	0 (0.0)
Exitus		0 (0.0)	2 (10.5)	1 (16.7)

CNS: central nervous system, CSF: cerebrospinal fluid, SVT: sinus venous trombosis, DVT: deep vein thrombosis

meningiomas were headache (19 patients) and vertigo (7 patients), with only 1 patient presenting with hearing loss. In schwannomas, the most common presenting complaint was also headache (11 patients), followed by hearing loss (7 patients) (Table 3).The most frequently observed findings during examination in the entire population were hearing loss (29.1%) and facial palsy (9.1%). In 61.8% of patients, neurological examination was normal. Further details are provided in Table 1. Hearing loss was present in 12 among schwannoma patients in contrary to 3 in meningioma patients had. Both schwannoma

and meningioma groups had 2 cases of facial palsy at the time of presentation (Table 3).

52.7% of tumors were located on the right side and one patient had bilateral tumors. The average diameter of the PCA tumors in this study was 33.60 ± 10.62 mm (Table 1). Gross total resection was achieved in all cases.

During the postoperative period, new neurological deficits or complications developed in 26 patients (47.3%) (Table 2). The number of patients who developed facial palsy was 14 (25.4%), with 1 having a primary meningioma and 13 having a schwannoma. Eight patients completely recovered during follow-up. Three patients (5.5%) developed dysphagia, all of which were temporary and resolved completely. In addition, 7 patients (12.7%) developed central nervous system (CNS) infections, 5 (9.1%) had CSF leakage, and 5 (9.1%) had pneumonia. Overall 9 of the meningioma patients, 13 of the schwannoma patients, and 2 of the epidermoid tumor patients had one or more complications. The postoperative complications observed in our series are listed in Table 2 and Table 3.

The mean follow-up period of the cases was 19.49 ± 21.61 months. A total of 5 patients (9.1%) died. One case had a metastatic tumor, and 2 cases were lost in the early period due to infections. The condition of 6 patients (10.9%) was worse than the preoperative period. These were patients who developed postoperative facial palsy and did not recover. In 65.5% of the patients (n=36), there was no difference between the preoperative condition and the last follow-up. Among these patients, 29 did not have neurological deficits initially. The condition of 8 patients was better at the last follow-up compared to the preoperative period (Table 2).

DISCUSSION

Analysis of the data regarding the surgical treatment of PCA tumors in our department revealed that the majority of cases were seen in females. The most common presenting complaint was headache, and the most frequent examination finding was hearing loss. However, most patients did not have any examination findings. When examining the histopathological types, the most commonly observed tumors were meningiomas and schwannomas. While gross total resection was achieved in all patients, cranial nerve injury was more frequent in vestibular schwannomas.

PCA tumors constitute 5-10% of all brain tumors, with vestibular schwannomas accounting for 70-90%, meningiomas for 5-15%, and epidermoid tumors for 6% of PCA tumors (9). Interestingly, in our series, it was observed that the number of meningioma cases slightly exceeded the number of schwannoma cases. This may be due to the relatively small size of the population or characeristics of the region. Samii et al. identified neurofibromatosis type 2 in 82 out of 962 cases with bilateral schwannomas in their series (10). In our series,

bilateral schwannoma was only observed in 1 patient, but neurofibromatosis was not present.

Some clinical differences between acoustic and non-acoustic tumors have been demonstrated in the literature (11, 12). Compared to vestibular schwannomas, audiovestibular symptoms (hearing loss, tinnitus, vertigo) are less common in meningiomas, whereas cerebellar symptoms, facial palsy, and hydrocephalus are more frequent in the latter (11-13). Similarly, in our series, 7 out of 19 schwannoma cases presented with hearing loss, while only one of the 23 meningioma cases described hearing loss. In terms of neurological evaluation, hearing loss was detected in 12 cases in the first group and only in 3 cases in the second group. None of the epidermoid tumor cases in our series had a history of recurrent aseptic meningitis. An important finding was that 71% of patients with meningiomas exhibited no positive examination findings. Considering this, patients with complaints but no examination findings are recommended to be evaluated with imaging studies to avoid misdiagnosing these cases.

The goal in treatment of vestibular schwannomas is gross total tumor resection while preserving neurovascular structures (8). Gross total resection rates of 97-99% and mortality rates of around 1% were reported in the literature (10, 14). Samii et al. reported that the cochlear nerve can be preserved in 39.5% of cases, and the facial nerve can be preserved in 61-70% of cases (10). The rate of CSF fistula development ranges from 2% to 30% (8). In our center, our primary goal is gross total resection in all PCA tumors regardless of pathology. As a result, the gross total resection rate was 100%. There were 2 exitus. Facial nerve injury occurred in 13 patients, and 8 of them recovered during the follow-up period. Temporary dysphagia developed in one patient.

Similar to schwannomas, the goal of surgical treatment for meningiomas is to achieve the widest safe resection -including resection of dural attachments and hyperostotic bone- while preserving cranial nerves, (9, 15). The reported rates for gross total resection, mortality, temporary/permanent facial palsy, and dysphagia are 45-86%, 0-5%, 30%/10%, and 2-12%, respectively (16). Gross total resection was achieved in all meningioma cases in our series. One patient had permanent facial palsy, while two patients experienced temporary swallowing difficulties. The lower incidence of cranial nerve involvement in meningiomas compared to vestibular schwannomas explains the lower occurrence of cranial nerve related complications in the postoperative period. In addition, three cases of CNS infection, two cases of CSF fistula, one case of pneumonia, one case of wound infection, and one case of deep vein thrombosis were detected. Also, the rate of patients that experienced surgical complications was lower in meningioma

patients compared to schwannoma patients, however no statistical analysis was performed in this regard. No patient with meningioma died postoperatively.

The definitive surgical treatment of epidermoid tumors require complete excision of the tumor including the tumor capsule (9). However, due to the tight adherence of the capsule to neurovascular structures, safe and complete excision can be challenging, and recurrence is possible (9). The gross total resection rate ranges from 33% to 88%, and postoperative complications may include facial palsy (0-23%), hearing loss (8-10%), and swallowing problems (0-10%) (17, 18). In our series, gross total resection was achieved in all six cases of epidermoid tumors, and no cranial nerve related complications were observed. 1 patient died.

Malignant tumors are characterized by the rapid onset of symptoms, and their treatment is challenging due to the invasion of vital structures in the region. Malignant lesions in this localization have a poor prognosis, and while complete removal is not impossible, it is difficult to achieve (19).

CONCLUSION

PCA tumors constitute a significant group of intracranial tumors. Surgical treatment is an important option in the management of these tumors. With advances in surgical techniques and instruments, gross total resection is largely achieved, and although neurovascular complications still occur, permanent damage rarely occurs.

Ethical Approval: Ethics committee approval for this study was received from Dicle University Medical Faculty Committee for Noninterventional Studies (Date: 17.01.2023, No: 38).

Author Contributions:

Concept: İB, SB, Design: İB, SB, TY, Supervision: TY, Data Collection and/or Processing: İB, SB, TY, Analysis and/or Interpretation: İB, SB, Writing: İB, SB, TY,

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