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Surgical Treatment of Intracranial Epidermoid Tumors

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Abstract

Intracranial epidermoid tumors are rare, potentially curable, benign lesions that are sometimes associated with perioperative complications, and tend to recur if not completely removed. Histologically benign epidermoid tumors may also develop into highly malignant tumors. This study evaluated on 28 cases of intracranial epidermoid tumor treated over a 13-year period by radical resection with microneurosurgical techniques. The majority of patients underwent computed tomography and/or magnetic resonance imaging within the first 24 hours postoperatively to confirm the results of surgery. Radical surgical resection was achieved in 21 of the 28 cases, and there was no operative mortality. The most common postoperative complication was transient paresis of various cranial nerves. During a mean follow up of 6 years, only one tumor became malignant. Radical surgical resection should be the goal in treating these benign lesions, but if not possible, every effort should be made to minimize the amount of tumor tissue that remains.

Key words: epidermoid tumor, aseptic meningitis, microneurosurgery

Introduction

Intracranial epidermoid tumors are rare, histologically benign, slow-growing, congenital neoplasms of the central nervous system (CNS) that may arise from retained ectodermal implants.[2,5,8,24,25,31,33] Epidermoid tumors are the most common of all embryonal intracranial neoplasms, and account for 0.2–1.8% of all intracranial tumors and 7% of cerebellopontine angle (CPA) tumors.[2,5,15,16,24,28,29,31,33,35] Epidermoid tumors tend to spread along normal cleavage planes, and slowly fill any available subarachnoid space, including the sulci, cisterns, fissures, and ventricles.[3,8,15,24] The expanding tumor conforms to the shape of the cavities and does not disturb normal neuronal and vascular structures. Instead, epidermoid tumors usually adhere to and surround these vital structures during growth.[13,16,29]

Epidermoid tumors can cause irritation of the cranial nerves resulting in trigeminal or glossopharyngeal neuralgia, or hemifacial spasm.[8,15,20,24,29,32] Permanent cranial nerve paralysis usually only occurs after the tumor had adhered to the nerve and caused ischemia. Epidermoid tumors are histologically benign but carry a significant risk of perioperative complications, including permanent cranial nerve deficits, hydrocephalus, and aseptic meningitis due to breakdown products (keratin and cholesterol) produced during the desquamation of epithelial cells.

The present study evaluated cases of epidermoid tumor treated at our hospital with regard to clinical characteristics, surgical findings and results, complications, and outcomes based on long-term follow up, to determine the best surgical techniques and approaches for this special group of CNS tumors.

Materials and Methods

Twenty-eight patients underwent surgical treatment for intracranial epidermoid tumors at Cerrahpasa Medical Faculty Hospital between 1986 and 2001. Data were retrospectively collected from the clinical, surgical, pathological, and neuroradiological records. We retrospectively reviewed the cases and analyzed the clinical examination records. Tissue specimens from all cases were examined by attending neuropathologists from the Department of Pathology, Cerrahpasa Medical Faculty, University of Istanbul. The data were analyzed based on simple

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proportions, means, and medians. All available information was used to determine the patients' status during follow up. Postoperative neuroradiological studies were done in all patients, with a mean follow up of 6 years (range 1–12 years).

Results

The 16 male and 12 female patients were aged 22–69 years (mean 40 years). Most patients were in their fourth or sixth decades of life. Clinically, the most common presenting symptoms were headache (11 cases) and dizziness (9 cases). Headache was the most common presenting symptom of tumors located in the supratentorial compartment (6 of 8 supratentorial tumors). The most common clinical manifestation of posterior fossa tumors was dizziness (9 of 20 cases), followed by facial pain (6 cases), hearing loss (5 cases), diplopia (4 cases), facial spasm and asymmetry (3 cases), and tinnitus (3 cases). Loss of consciousness was the presenting symptom in two cases of the supratentorial tumors and in one case of infratentorial tumor. The median duration of symptoms was 4.6 years (range 10 months to 10 years).

Neurological examination revealed 21 cranial nerve pareses in 15 of the 28 patients. The nerve(s) affected, and the severity and duration varied. Only two of these 15 patients had tumors located in the supratentorial regions. Other neurological deficits encountered included cerebellar signs in seven cases, nystagmus in five, trigeminal neuralgia in three, motor deficits in two, and hemifacial spasm in one case. Cranial nerve VIII was most commonly affected (6 patients), followed by cranial nerves V (5 patients), VII (4 patients), IX–XI (3 patients), III (2 patients), and VI (1 patient).

The most common location in our series was the posterior fossa (20 cases). Seventeen of these 20 tumors were located in the CPA (Fig. 1), two in the fourth ventricle, and one in the cisterna magna. The other eight tumors were in supratentorial locations; four in the sylvian fissure, two in the occipital lobe, one in the lateral ventricle, and one in a primary intradiploic location (Table 1).

Epidermoid tumors in the CPA were removed via the suboccipital retrosigmoid approach in the sitting position. The same position was also used for the infratentorial tumors. Tumors located in the sylvian fissure were removed via a pterional approach. Tumors located in the occipital lobe were removed in the prone position via an occipital craniotomy. The only tumor located in the lateral ventricle was removed via an anterior transcallosal approach. Radical resection (gross total + radical subtotal)

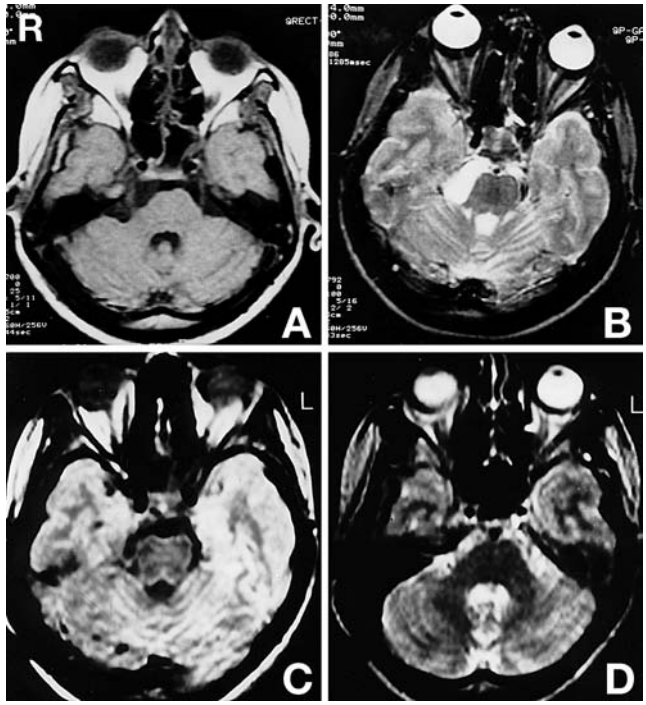


Fig. 1 A, B: Preoperative T_1- (A) and T_2-weighted (B) magnetic resonance (MR) images showing an epidermoid tumor in the right cerebellopontine angle. C, D: Postoperative T_1- (C) and T_2-weighted (D) MR images of the same patient demonstrating total removal of the epidermoid tumor.

was achieved in 21 cases, and only subtotal resection was possible in seven. There was no operative mortality in our series.

The most common postoperative complication was cranial nerve paresis in 13 patients with 23 separate nerve deficits. Six patients experienced 16 different transient cranial nerve pareses in the immediate postoperative period, all of which subsided within a few weeks of surgery. The nerves most commonly affected in the postoperative period in descending order were cranial nerves VIII, III and VII, V, VI, and the lower cranial nerves. Unfortunately, seven patients developed permanent paralysis of different cranial nerves; lower cranial nerves were affected in three patients, VII in two, VIII in one, and III in one. None of these seven patients showed improvement during the long-term follow up. There were five cases of hydrocephalus and two cases of aseptic/chemical meningitis. Three of the 28 patients in this series required shunting procedures to treat irritative communicating postoperative hydrocephalus that developed during the course of their disease, and one of these patients developed postoperative aseptic meningitis.

Table 1 Clinical characteristics and operative results of 28 patients with epidermoid tumors

Case No.	Tumor location	Preoperative cranial nerve deficits	Extent of removal	Complications	Postoperative cranial nerve deficits	Permanent cranial nerve deficits	Recurrence
1	CPA	V–VIII	total		VIII		
2	CPA	VII–VIII	subtotal		V–VII–VIII		
3	CPA	VII–VIII–(IX–X–XI)	subtotal	chemical meningitis	(IX–X–XI)	(IX–X–XI)	recurrence (malignant degeneration), reoperation
4	CPA	VIII–(IX–X–XI)	total		VIII–(IX–X–XI)	(IX–X–XI)	
5	CPA	VII–VIII	total	hydrocephalus, shunt	VII–VIII	VIII	
6	CPA	VII	subtotal		VII	VII	recurrence, reoperation
7	CPA	V	total	hydrocephalus	III–V		
8	CPA	V	total		V–VII		
9	CPA	V	subtotal	hydrocephalus, shunt, chemical meningitis	III–VI–VII–VIII		
10	CPA	VI	total		VI–VII	VII	
11	CPA	(IX–X–XI)	subtotal		(IX–X–XI)	(IX–X–XI)	
12	CPA		total	hydrocephalus, shunt			
13	CPA	V	total				
14	CPA	VIII	total		VIII		
15	CPA		total				
16	CPA		total				
17	CPA		total				
18	fourth ventricle		total	hydrocephalus			
19	fourth ventricle		total				
20	cisterna magna		total				
21	sylvian		total				
22	sylvian	III	total	motor deficit	III	III	
23	sylvian		subtotal	chemical meningitis			
24	sylvian	III	subtotal	motor deficit			
25	occipital		total				
26	occipital		total				
27	lateral ventricle		total				
28	temporal intradiploic		total				

CPA: cerebellopontine angle.

The majority of patients were followed up with computed tomography (CT) and/or magnetic resonance (MR) imaging within the first 24 hours postsurgery to assess the results of surgery. Patients with residual tumor tissue were followed up with MR imaging every 6 months for 2 years, and yearly thereafter. The follow-up period in our series ranged from 1 to 12 years (median 6 years). Two patients had to undergo second surgery due to tumor recurrence in the follow-up period. One patient with recurrent disease developed malignant degeneration to squamous cell carcinoma 1.5 years after the initial surgery. Her tumor was located in the CPA, and she died in the 5th month after the second operation. The other recurrent tumor was also located in the CPA, and the patient required surgery 6 years after the first operation.

Discussion

The epidermoid tumors in our series represented 1.4% of all intracranial neoplasms and 8.2% of all CPA tumors treated at our hospital during a 13-year period. The CPA is the most common location for intracranial epidermoid tumors, as 40% of all these tumors are found at this site.[2,5,15,16,24,28,29,31,33,35] In our series, 20 of 28 tumors were located in the posterior fossa, and 17 in the CPA.

Patients first present with epidermoid tumor at a mean age of 40 years, and symptoms usually arise in the third and fifth decades as found in our series and others.[7,8,16,24,29,33] The signs and symptoms develop

late in the course of tumor growth, with a median duration of 2 to 4 years, so acute onset is rare.[6,8,22,25,29,31,33] The median duration of symptoms in our series was 4.6 years, and none of our patients was diagnosed with aseptic meningitis in the preoperative period.

The most common sequelae of posterior fossa epidermoid tumors are cranial nerve involvement and cerebellar dysfunction.[2,10,13,20,22–24,30,31,33,35] Preoperative neurological assessments of our patients revealed cranial nerve involvement in 15 cases (54%). The most likely explanation is that the majority of tumors in our series were located in the posterior fossa, in particular in the CPA.

Epidermoid tumors are histopathologically benign, so the goal of treatment should be complete surgical resection with no damage to vital neurovascular structures.[2–4,8,10,16,19,23,30,31,33] Occasionally, extensive tumor growth infiltrating the brain parenchyma can involve vital structures that cannot be sacrificed, and tight adherence of the capsule to neuronal and vascular anatomy is rare but makes total removal difficult.[3,7,8,11,18] Another obstacle to complete resection is the spreading growth of these tumors, invaginating into and expanding through weak points in the brain parenchyma. Epidermoid tumors are distinguished from other types of intracranial tumors by the higher incidence of cranial nerve paresis, which does not occur secondary to a mass effect or nerve displacement. Such cranial nerve paresis is most likely due to adherence of the tumor to the nerve, resulting in ischemia.[31] Only 50% to 80% of intracranial epidermoid tumors can be completely removed.[9,31] Complete removal can diminish the risk of postoperative aseptic meningitis, and will prevent recurrence of the symptoms.[12,14,16,24,29]

In our series, we achieved radical resection (gross total + radical subtotal) in 21 of 28 cases, and subtotal resection in seven. Thirteen patients in our series developed various forms of cranial nerve paresis in the postoperative period. Our findings confirm that cranial nerve deficits that are already present seem to increase in quantity and severity during the postoperative period in some patients. This may be due to surgical manipulation of an already damaged nerve, which increases the number of ischemic events and can lead to irreversible cranial nerve damage. However, in the majority of cases, these deficits subside in the postoperative period. Most of the deficits in our patients were transient (16/23 pareses), and only seven individuals developed permanent nerve paralysis (Table 1). Every effort should be made to maintain the integrity of all anatomical structures during surgery, to prevent irreversible cranial nerve damage and promote resolution of any preoperative paresis after the surgery. We found that patients who had preoperative paresis involving the lower cranial nerves were more likely to suffer permanent nerve damage.

A significant number of complicated epidermoid tumors are difficult to excise due to adherence to vital neurovascular structures, which is especially true for tumors located in the CPA. The surgeon should take care to prevent undue morbidity due to radical surgical resection in these cases, and possibly should not attempt to remove portions of the tumor capsule that are tightly attached to vital neuronal and vascular structures.[3,7,20,29] We use microdissection techniques to separate the cranial nerves from the tumor capsule, especially in young individuals. Although recurrence should be expected if residual tumor tissue remains, the period for recurrence of epidermoid tumor is so long that symptoms are unlikely to recur within a patient's lifespan.[3,35] Still, every effort should be made to achieve total or near-total resection, particularly in the first operation, to diminish the chance of recurrence and achieve a positive postoperative outcome.[2,7,13,16,29]

Chemical meningitis caused by spontaneous rupture of the highly irritative cystic tumor contents into the subarachnoid space is estimated to occur in 40% of patients with epidermoid tumor who undergo subtotal resection.[9,16,33] The risk of postoperative aseptic/chemical meningitis may be directly linked to the amount of residual cyst lining. The risk of developing aseptic meningitis can be reduced by taking care to avoid spillage of the cyst contents into the subarachnoid space, by removing all lining tissue, and by administering corticosteroids perioperatively.[6–9,11,16,17,29,33,35] Irrigation of the surgical site with hydrocortisone (100 mg/l in lactated Ringer's solution) also reduces the risk of postoperative communicating hydrocephalus and aseptic meningitis.[1,3,8,11,17] Radical resection was successful in 21 of our 28 patients, and there were three cases of chemical meningitis in the postoperative period. All our patients routinely received corticosteroids in the perioperative period, and the surgical field was irrigated with normal saline during all operations.

Communicating hydrocephalus may develop after one or more particularly intense periods of meningitis, or following leakage of cyst contents from the operative field. In a previous study, eight of 42 patients required shunting procedures during the course of their disease; six for noncommunicating hydrocephalus and two for irritative communicating postoperative hydrocephalus.[35] In our series, only one of the patients who required shunting

developed chemical meningitis in the postoperative period. We believe that routine perioperative administration of corticosteroids and irrigation of the operative field with normal saline decreases the risk of hydrocephalus developing postoperatively.

Obviously, total resection eliminates the chance of epidermoid tumor recurrence.[8,21,35] However, previous studies involving long-term follow up have revealed an overall estimated recurrence rate of 24% for this tumor. As mentioned, patients with only a small amount of residual tissue after surgical resection are at low risk for recurrence during their lifespan. However, although these tumors are histopathologically benign, rare cases have shown a tendency toward malignant degeneration, particularly to squamous cell carcinoma.[1,26,29,31] Over a median follow up of 6 years in this series, only two patients required surgery due to recurrent symptoms. In one case, there was malignant degeneration to squamous cell carcinoma, and this patient died 5 months after the second surgery. Enhancement of the epidermoid tumor on MR imaging or CT suggests the possibility of a malignant epithelial component. These tumors are normally not enhanced by contrast administration because of the absence of a well-developed vascular network.[1,6,8,15,18,27,30,31,34,35]

Epidermoid tumor commonly causes persistent distortion of brain parenchyma, even after satisfactory surgical resection.[2,15] Routine follow-up MR imaging is valuable, and may reveal peritumoral encephalomalasic regions and unsuspected lesions. Patients with remnant tumor can be monitored safely for asymptomatic recurrence through noninvasive neuroimaging techniques. Early detection through routine MR imaging may improve surgical outcome in recurrent cases, since the tumors are more amenable to surgery at this stage.[4,9,22,23,29,35]

In conclusion, intracranial epidermoid tumors should be treated with radical surgical resection. Since these are benign tumors, complete removal should be the goal. However, a significant number of complicated epidermoid tumors are difficult to excise due to adherence to the neurovascular structures. In our opinion, the surgeon would be prudent not to disturb sites where the tumor capsule is tightly adhered to vital neuronal and vascular structures, as attempts to remove this tissue are certain to increase morbidity and mortality. Epidermoid tumors grow slowly, and the period between subtotal resection and recurrence is relatively long, so some of the tumor capsule adherent to vital structures can be left in place if total removal would sacrifice neurological function. However, every effort must be made to achieve total resection or to leave minimal tumor tissue in place, since the biological properties may lead to higher mortality and morbidity in patients with recurrent symptomatic disease. This approach will reduce the chance for development of postoperative aseptic meningitis, and also prevent recurrence of symptoms during the patient's lifespan.

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Commentary on this paper appears on the next page.

Commentary

Dr. Akar and colleagues presented a series of 28 cases operated for epidermoid tumors. The location and spread of the tumors were studied. The authors claimed that they can treat these kinds of tumors with microneurosurgical techniques. The postoperative sequelae are listed. In the opinion of the authors, radical surgical resection is the optimal treatment. However, in their series it was not possible in 7 cases. Beside cranial nerve(s) paresis, they also had cases with postoperative hydrocephalus, which they thought was the result of chemical meningitis after surgery. All the data presented in this report are well-known and have already been previously presented in the literature.

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The authors attempt to discuss the entire subject of epidermoid tumor in this presentation. Unfortunately, the subject of epidermoid tumor is very extensive, and it is impossible to compile all the information and facts in a relatively short presentation. The paper could have been more informative and more readable if the authors had discussed only epidermoids in one particular location and had described the variety of issues related to the tumors in that region in greater length.

Epidermoids are slow growing tumors and grow over several years into various crevices of the brain. Whilst small tumors usually present with symptoms of hemifacial spasms or trigeminal neuralgia, larger tumors usually present with symptoms related to neural distortion and cranial nerve stretching. Despite the frequently encountered large size, invasive growth pattern and location in critical areas, they usually present with only subtle symptoms. The more common location of these tumors is in the region of the tentorial hiatus anterior or anterolateral to the brainstem and they extend and open widely the cisterns located between the cerebellum and midbrain, cerebellum and pons and cerebellum and medulla. The fifth, seventh-eighth and lower cranial nerves are generally displaced laterally by the tumor bulk. The basilar artery is frequently displaced away from the pons and the tumor can complete encase the artery and the perforators. Supratentorial extension is frequently seen. Considering this location, we prefer the term ''tentorial'' or ''petroclival'' instead of ''cerebellopontine angle'' epidermoid tumor.

Surgery for these tumors has to be based on high surgical skills and strong philosophical considerations. The responsibility of the surgeon is that whilst he tries to radically resect the tumor and attempt a cure, at the same time he should preserve the neurological function of the patient. The tumors are soft, friable and avascular, and relatively easy to resect. The brain is lax and easy to retract. The ease of tumor resection is circumvented by the usually large size, high invasiveness and severe cranial nerve distortion. The exposure for tumor resection should be large and should provide a viewing angle into the crevices. Although a large exposure is necessary to radically remove these tumors, we have observed that ''skull base'' approaches that incorporate petrous bone drilling can be safely avoided. For achieving a ''total'' resection, it is important to resect the capsule of the tumor. However, the teasing off of the capsule of the epidermoids away from the cranial nerves can result in injury to the nerves. The surgical challenge in these cases is the skill and judiciousness with which the surgeon removes the capsule. In case there is any difficulty in dissecting the capsule, it has been uniformly observed that it is better to leave a part of capsule along with the nerve. The authors have not discussed the issue of ''capsular'' resection in their case material. The radicality of the tumor resection will vary with its location and with its relationship to adjoining structures. The radicality or completeness of the tumor resection will be higher in supratentorial tumors than in tentorium based tumors.

The authors have mentioned and referenced a relatively high incidence of post-operative chemical meningitis and hydrocephalus. In our experience, the incidence of both these complications is significantly low.

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