Anterior Transpetrosal Approach to the Prepontine Epidermoids

ABSTRACT—We have operated on nine patients with a prepontine epidermoid extending to the bilateral cistern or the unilateral middle fossa using the anterior transpetrosal approach since 1986. The preoperative symptoms were unilateral trigeminal neuralgia, hearing disturbance, gait disturbance, double vision, facial hypesthesia, hemifacial spasm, and dysphagia. The most common neurological sign was unilateral trigeminal nerve disturbance. In two patients with useful hearing preoperatively lost, the labyrinth and mastoid air cells as well as the petrous apex were resected to extend the surgical field. Tumors were totally removed, except for capsules that were tightly adhered to the brain stem, cranial nerve, and vessels. The trigeminal neuralgia, hemifacial spasm, and dysphagia disappeared, but double vision improved only one out of three cases, and facial hypesthesia was unchanged in all cases. There were no postoperative deaths. New abducens palsy appeared in four cases and cerebrospinal fluid (CSF) leakage appeared in three cases postoperatively, but later these symptoms disappeared. In one case, postoperative chemical meningitis developed, and a ventricular shunt was required later to treat hydrocephalus. Postoperative follow-up, an average of 5.7 years, did not show any increases in any of the tumors. Based on our experience, we conclude that the anterior transpetrosal approach is more useful than the retromastoid suboccipital approach to resect the epidermoid located mainly in the prepontine cistern.

Epidermoid tumors are congenital malformation arising early in gestation as the result of inclusion of one or more cells of the skin ectoderm.^{1,2} Unlike most tumors, which have an exponential growth, epidermoids grow at a linear rate that resembles the growth of human epidermis.¹ Therefore, these are defined as benign tumors with slow growth, but some cases have been reported which required multiple operations after an incomplete removal of the tumor in the initial operation.³⁻⁶ These cases emphasize the importance of the initial operation. Total removal is considered to be ideal, but forced removal leads to worsening postoperative morbidity, as the tumor capsule often tightly adheres to the important structures, such as vessels, cranial nerves, and brain stem.⁶⁻¹¹ Since 1986, we have operated on nine patients with a prepontine epidermoid

extending to the bilateral cistern or the unilateral middle fossa using the anterior transpetrosal approach reported by Kawase.^{12,13} In this paper, we report surgical results and complications to discuss usefulness of our approach in comparison with previously reported approaches.

SURGICAL CASES

Nine patients, seven males and two females, mean age 45 (ranging from 31 to 61) were evaluated (Table 1). The tumors extended to the bilateral cistern in four cases, and to the unilateral middle fossa in five cases. The most common neurological sign was unilateral trigeminal nerve disturbance. Five patients complained of trigeminal neuralgia, three patients complained of fa-

Table 1. Clinical Presentations of Patients

Case (Age/Sex)	Tumor Spread	Neurological Signs	Symptoms
1(50/M)	Bilateral cistern	III, V Cerebellar ataxia	Double vision V-neuralgia Gait disturbance
2(31/M)	Middle fossa	V	V-neuralgia
3(52/M)	Middle fossa	V, VII	V-neuralgia Hemifacial spasm
4(54/F)	Middle fossa	V, VIII	V-neuralgia Facial hypesthesia Hearing disturbance
5(40/F)	Middle fossa	V	V-neuralgia
6(42/M)	Bilateral cistern	VI, IX, X Cerebellar ataxia	Double vision Dysphagia Gait disturbance
7(44/M)	Middle fossa	V	Facial hypesthesia
8(31/F)	Bilateral cistern	VIII	Hearing disturbance (not useful)
9(61/M)	Bilateral cistern	V, VI, VIII Cerebellar ataxia	Facial hypesthesia Double vision Hearing disturbance (not useful)

cial hypesthesia, and one patient complained of both. Four out of the five patients with the tumors progressing to the unilateral middle fossa showed trigeminal neuralgia. Three out of the four patients with the tumors progressing to the bilateral cistern showed gait disturbance, because the brain stem and the cerebellum were compressed posteriorly by the tumor. Two out of the three patients with hearing disturbance had lost useful hearing before the operation. Useful hearing was defined as an average hearing loss of less than 50 decibels and a speech discrimination rate of more than 50%. Three patients complained of double vision caused by abducence palsy, and one patient was suffering from hemifacial spasm. These nine cases included patients who had undergone previous operations with either suboccipital or subtemporal approach—five times in Case 9 and once in Case 1 and Case 6. In all nine cases, the operations were performed through the anterior transpetrosal ap-

proach (Fig. 1). In the seven cases whose useful hearing was retained, only the petrous apex was resected, and in the two cases with useful hearing loss, the labyrinth and mastoid air cells as well as the petrous apex were resected to extend the surgical field to the antero-lateral side of the medulla oblongata (Fig. 2). These bone defects were covered with pediculate temporal fascia by the use of fibrin glue at the end of operation to prevent postoperative cerebrospinal fluid (CSF) leakage.

Figure 1. Skin incision and site of craniotomy for anterior transpetrosal approach. The dotted line indicates the skin incision for the anterior transpetrosal approach combined with a zygomatic approach. TM = temporal muscle; TF = temporal fascia.

Figure 2. Surgical anatomy of the right pyramidal bone by the anterior transpetrosal approach. A dotted line indicates the area of bone resection. No organic structures are sited in this area. In the cases in which useful hearing has already been lost, the labyrinth and the mastoid air cells can be drilled out to extend the operative field. ZA = zygomatic arch; EAM = external auditory meatus; FO = foramen ovale; MMA = middle meningeal artery; ICA = internal carotid artery; EA = eminencia arcuata; PN = greater and lesser superficial petrosal nerve; G.G. = Gasserian ganglion; and PA = petrous apex.

RESULTS

All tumors were totally removed, except for capsules that were tightly adhered to the brain stem, cranial nerves, and vessels (Fig. 3). The perforating arteries and cranial nerves were preserved in all cases. Trigeminal neuralgia, hemifacial spasm, and dysphagia disappeared. Gait disturbance disappeared in one patient, and improved in the others. Double vision improved in one of the three patients and remained unchanged in the others. Facial hypesthesia was unchanged in all three patients. Hearing disturbance deteriorated in two patients due to intraoperative resection of the labyrinth (Table 2). There were no postoperative deaths. New abducens palsy appeared in four cases, but disappeared with 6 postoperative months in all cases. CSF leakage appeared in three cases, but disappeared with bedrest for about 1 week in all cases. Postoperative chemical meningitis developed in one case, and became communicating hydrocephalus, later requiring a ventricular shunt (Table 3).

Postoperative follow-up, ranging from 14 months to 10 years (mean 5.7 years), did not show any increases in any of the tumors. Seven out of the nine patients are alive and well. As for the rest, neurological signs remained after the operation in one patient (Case 9), who is still able to live independently, but unable to resume work, and the other (Case 1) died of malignant testicular tumor (Table 3).

DISCUSSION

Because an epidermoid grows with involvement of important vessels, including the perforating artery and cranial nerves, in the tumor,^{8,10,14} or with the tumor capsule tightly adhered to such important structures, forced removal leads to worsening postoperative morbidity.^{5-8,10,11,15} However, many reports state that incomplete removal has resulted in recurrence of the tumor, in spite of the slow growth rate of the tumor, and that the outflow of cholesterol and keratin in the residual tumor

Figure 3. T1-weighted image with Gd enhancement of Case 6. This patient had undergone an operation with a suboccipital approach 5 years before this operation. As hearing disturbance was not a complaint, only the petrous apex was resected (A). T1-weighted image taken a year after the operation (B). The tumor was totally removed except for the capsule tightly adhered to the cranial nerves.

Table 2. Changes in the Symptoms

<i>Preoperative Symptoms (No. of Patients)</i>	<i>Disappeared</i>	<i>Improved</i>	<i>Unchanged</i>	<i>Deteriorated</i>
Trigeminal neuralgia (5)	5	0	0	0
Hearing disturbance (3)	0	0	1	2
Gait disturbance (3)	1	2	0	0
Double vision (3)	0	1	2	0
Facial hypesthesia (3)	0	0	3	0
Hemifacial spasm (1)	1	0	0	0
Dysphagia (1)	1	0	0	0

into the CSF caused chemical meningitis.^{3-6,8,11,16-19} In addition, in cases that developed chemical meningitis, adhesion of the tumor to peripheral structures is more severe, and the repeat operation is more difficult.^{8,18} Therefore, we consider that the operative purpose of the epidermoid should be to remove the tumor and the tumor capsule as completely as possible, except for the site that adheres tightly to nerves and blood vessels. For this purpose, it is more important to select a suitable operative approach for the site of the tumor. Yasargil¹¹ commented that as removal of the tumor progressed, an artificial surgical channel was created, so even large tumors extending from the cerebello-pontine angle to the parasellar cistern could be radically resected through a lateral retromastoid suboccipital craniotomy. However, it is difficult to remove a tumor that extends to the pre-pontine lesion, especially to the contralateral cistern, through a suboccipital approach and the tumor extending into the Meckel's cave can not be resected without resection of the petrous apex. The anterior transpetrosal approach, excising the petrous apex and reaching the anterior lateral side of the pons, allows direct visualization of the cranial nerves, basilar artery and its perforating arteries, which is useful for tumor removal at this site, preventing irreversible injury.¹³ In addition, this approach allows the removal of tumors extending into the Meckel's cave and behind the Gasserian ganglion by opening the Meckel's cave to mobilize the trigeminal

nerve, and has the advantage of freedom from sacrifice of hearing¹³ (Fig. 4).

In Cases 8 and 9, in which the tumor is so big that it compressed the whole width of the brain stem, the part progressing to the caudal side from the internal auditory meatus could not be reached with this approach (Fig. 5). However, in such cases, the useful hearing was usually already lost before the operation, and therefore it is possible to extend the operative field to the anterior lateral side of the medulla oblongata by the resection of the labyrinth and the mastoid air cells, in addition to the petrous apex, and to remove the tumor up to the jugular foramen (Fig. 6).

We experienced new abducens palsy in four out of nine patients postoperatively, but it disappeared spontaneously within 6 postoperative months in all cases.

Our surgical approach is not free from the risk of postoperative CSF leakage in association with the resection of the pyramidal bone, and in fact we have experienced the complication. This complication, however, disappeared only with bedrest for 1 week. We think, therefore, that such a risk can be prevented by covering the bone defect with pediculate temporal fascia using fibrin glue intraoperatively and by bedrest for a few days postoperatively.

Many previous reports describe that the cerebello-pontine angle epidermoids with supratentorial extension can be radically resected by a single retromastoid ap-

Table 3. Surgical Results

<i>Case</i>	<i>Tumor Removal</i>	<i>Complications</i>	<i>Follow-up (yrs)</i>	<i>Outcome</i>
1	Nearly total	Abducens palsy Chemical meningitis Liquorrhea	1.2	Dead*
2	Total	Abducens palsy	10.5	Good recovery
3	Total	(-)	10.1	Good recovery
4	Total	Abducens palsy	9.7	Good recovery
5	Total	Liquorrhea	7.0	Good recovery
6	Nearly total	Liquorrhea	4.0	Good recovery
7	Total	Abducens palsy	3.3	Good recovery
8	Nearly total	(-)	4.3	Good recovery
9	Nearly total	(-)	1.4	Mildly disabled

*Died of malignant testicular tumor.

Figure 4. An operative illustration after removal of the tumor by anterior transpetrosal approach (Case 7). This tumor extended into the Meckel's cave.

Figure 5. T1-weighted image with Gd enhancement of Case 8. The tumor extended toward the foramen magnum. As this patient had lost useful hearing before the operation, the petrous bone was resected widely.

Figure 6. An operative illustration after removal of the tumor by combination with resection of labyrinth and mastoid air cells (Case 8). A wide overview is shown from the oculomotor nerve to the glossopharyngeal nerve, as well as the contralateral abducens nerve. MPN = major superficial petrosal nerve; MMA = middle meningeal artery; PICA = posterior inferior cerebellar artery; AICA = anterior inferior cerebellar artery; BA = basilar artery; SCA = superior cerebellar artery; and PCA = posterior cerebellar artery.

proach, and that only in the patients with significant supratentorial extension, a combined approach or a staged procedure is needed.^{6,8-11,15,16,20-22} This opinion, however, is made on condition that the cerebellopontine angle epidermoids do not extend much past the midline, and generally do not invade the contralateral subarachnoid space.¹¹ Based on our experience, we conclude that the anterior transpetrosal approach is more useful than the retromastoid suboccipital approach to resect the epidermoid located mainly in the prepontine cistern, which extended to the bilateral cistern or to the unilateral middle fossa. The caudal limitation of this approach is the level of the jugular foramen in the patient with useful hearing loss. So the tumor that has already extended to the foramen magnum caudally should be resected by a combined approach or a staged procedure.

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