CASE REPORT

Cerebellopontine Angle Lipoma: A Rare Differential Diagnosis

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ABSTRACT—Intracranial lipomas in an infratentorial and extra-axial location are extremely rare. The presented case of an extensive lipoma of the cerebellopontine angle (CPA) represents 0.05% of all CPA tumors operated on in our department from 1978 to 1996. The lipoma constitutes an important differential diagnosis because the clinical management differs significantly from other CPA lesions. The clinical presentation and management of the presented case are analyzed in comparison to all previously described cases of CPA lipomas. The etiology and the radiological features of CPA lipomas are reviewed and discussed. CPA lipomas are maldevelopmental lesions that may cause slowly progressive symptoms. Neuroradiology enables a reliable preoperative diagnosis. Attempts of complete lipoma resection usually result in severe neurological deficits. Therefore, we recommend a conservative approach in managing these patients. Limited surgery is indicated if the patient has an associated vascular compression syndrome or suffers from disabling vertigo.

Intracranial lipomas are rare and presumably of maldevelopmental rather than neoplastic origin.¹⁻⁴ In 1818, Meckel described a lipoma of the chiasmatic cistern.³ The following reports date back to 1856 for the corpus callosum, the most frequent localization, and to 1859 for the cerebellopontine angle (CPA).^{5,6} Autopsy studies suggest incidences of 0.08% in general and 0.46% in preselected brain autopsy material.^{1,7} This correlates with data obtained by computed tomography (CT) screening of 17,500 patients where the overall incidence of intracranial lipomas was 0.06%. In the subgroup of 2,300 patients with brain tumors the incidence was 0.34%.⁸ Another study described five lipomas in 6,125 CT scans (incidence 0.08%).⁹ A more recent investigation observing three lipomas in 1,100 scanned brain tumor patients (0.3%) confirms that modern imaging techniques do not increase the incidence compared with autopsy studies.¹⁰

In a review of 150 patients, 81% of all lipomas were found supratentorially and 82% in the midline, where 50% were related to the corpus callosum.¹¹ Simi-

lar results are reported by others.^{4,12} Supratentorially, they often remain asymptomatic and can be associated with malformations.^{4,11} Lipomas of the CPA are different: They are not associated with malformations and can become symptomatic in a slowly progressive way by affecting the more susceptible of the cranial nerves in this region. As a result of the rare occurrence, the experience in treating and managing these tumors is limited. Consequently, the recommendations for treatment and for the role of surgery are very variable.^{4,13-17}

CASE REPORT

A 50-year-old teacher and mother of six children noticed a slowly progressing hearing loss and increasing tinnitus on the right side for 2 years. One year after onset of the symptoms she was unable to hear phone calls on the affected side and developed a pressure sensation behind the right ear. At this time she suffered a minor car accident and experienced since then a progressive unsteadiness with a fall tendency to the left

side. Reading became impossible because of a rotational vertigo. She was repeatedly disturbed by nausea.

Examination

Neurological examination revealed a mild nystagmus on gaze in all directions. There was a marked hearing deficit on the right. A loss of balance to the left in Romberg's test was noted. Gait ataxia increased with eyes closed. No other neurological deficits were detected. Further general clinical examination was without findings of note. The audiometry showed a tone perception threshold for air and bone conduction of 50 to 60 dB on the right and of 20 to 30 dB above 3 kHz on the left.

Neuroradiology

CT scans showed a very low density mass (-72.5 HU) within the right CPA without uptake of contrast media. Maximum diameter was 2 cm, and it extended from just above the foramen magnum up to the edge of the petrous bone. The mass seemed to be in close contact with the brain stem and rather to embrace it than to push it aside. Structures of higher density were present inside the lesion, suggesting cranial nerves (Fig. 1). In T_1 -weighted magnetic resonance imaging (MRI) scans the lesion was uniformly hyperintense and did not further enhance after application of contrast medium. Areas of lower signal intensity inside the mass suggested as well incorporated cranial nerves (Fig. 2). Both investigations therefore indicated a tumor with a high fat content, most likely a lipoma.

Figure 1. Preoperative axial nonenhanced CT scan at the level of the internal acoustic canal. A very-low-density structure is filling the right cerebellopontine cistern without causing a pronounced mass effect. Note the difference in signal density to cerebrospinal fluid (higher) and air (lower). A higher density structure inside the mass (arrow) most likely represents incorporated cranial nerves.

Surgical Management

A right retrosigmoid approach in a semi-sitting "lounging" position was chosen to expose the tumor. A large yellowish adipose mass was encountered enclosing cranial nerves VII to XI. With a broad base it was firmly adherent to the brain stem. After beginning piecemeal tumor removal, it became obvious that the highly vascular lipoma was too adherent to allow more than a partial resection without risking severe damage of all involved structures (Fig. 3).

Tumor Histology

The final report of the removed specimens described mature adipose tissue incorporating numerous and relatively large vessels, connective tissue, and single nerve fibers. The appearance was consistent with the diagnosis of a mature lipoma of the central nervous system (Fig. 4).

Postoperative Course

The patient recovered from surgery without additional neurological deficits. Tinnitus, balance problems,

Figure 2. Axial T_1 -weighted nonenhanced MRI scan at the level of the internal acoustic canal showing a very hyperintense cerebellopontine angle lesion. The band of lower signal intensity inside the mass (arrow) most likely represents incorporated cranial nerves.

Figure 3. Intraoperative view after exposure of the right cerebellopontine angle via the retrosigmoid approach and partial lipoma resection. The cranial nerves VII/VIII (asterisk) and the lower cranial nerves (arrow) are seen running through or being firmly attached to the lipoma.

episodes of nausea, and the pressure sensation inside the head had not disappeared completely at discharge. The postoperative audiometry was unchanged. One year later the patient complained of the same symptoms, but occurring less frequently. Reading was possible again. A control CT scan at this time showed no growth of the lipoma.

DISCUSSION

Including the present case, 30 lipomas of the CPA and internal acoustic canal (IAC) have been described in the literature between 1856 and 1996 (Table 1). None was associated with intracranial malformations, hydrocephalus, epilepsy, or retardation, as described for mid-

line lipomas.^{18,19} The mean age at the time of discovery was 41 years, ranging from 8 to 77 years. Five autopsy cases dating from before 1976 are included. Surgeons explored 22 lipomas, and in three the diagnosis was established by CT or MRI alone.

Incidence

The most common extra-axial sites for intracranial lipomas are the sylvian cistern and the CPA. The latter is the most common in the posterior fossa, harboring 6 to 12% of all intracranial lipomas.^{4,11,12} Reviews of CPA tumors 20 to 30 years ago did not mention lipomas at all.^{20,21} In a more recent survey they account for less than 1% of all CPA tumors, together with other unusual lesions.²² Among more than 2,000 surgically treated CPA tumors in our department, this is the only lipoma. We therefore estimate the incidence of lipomas among CPA space-occupying lesions to be around 0.05%.

Pathogenesis

Different theories of the etiology of the intracranial lipoma have been discussed. Recently Truwitt and Barkovich⁴ analyzed 44 patients with intracranial lipomas in an MRI study. They supported the idea of a congenital malformation and included basic data from other authors.^{3,23–25} The lipoma formation is considered to result from an abnormal persistence and lipomatous differentiation of the meninx primitiva. During the orderly dissolution of meninx primitiva the subarachnoid spaces and cisterns are formed. Lipomas originate if meninx primitiva persists and maldifferentiates. In other words, lipomas can be considered to be “maldifferentiated subarachnoid space.” Therefore, blood vessels and nerves are running through the lipoma and are not

Figure 4. Histological appearance of the removed fatty tissue. Large arteries (asterisk) and single nerve fibres (arrow) are located inbetween the mature fat cells.

Table 1. Summary of Reported Cases with Cerebellopontine Angle Lipoma

Author	Year	Sex	Side	Age	Symptomatic		Treatment	Incorporated	Outcome
					Cranial Nerve	Cranial Nerve			
Klob ⁶	1859	M	L	NM	VIII	VII, VIII	AU	VII, VIII	Autopsy case
Stefan ³⁵	1933	F	L	40	0	V-VIII	AU	V-VIII	Autopsy case
Budka ¹	1974	F	R*	26	VIII, V	VIII	IR	VIII	Neuralgia better 10 months
		M	L	77	VIII		AU		Autopsy case
Ianovici ⁴⁰	1976	NM	NM	50	NM		AU		Autopsy case
Fukui et al. ²⁹	1977	F	L	28	VIII		IR		Unchanged
Olsen et al. ³⁴	1978	M	L Ω	42	VIII		CR		Unchanged
		M	L Ω	59	VIII		CR		Well but deaf [†]
Winther and Reske-Nielsen ³²	1978	M	L	50	VIII		BX		Palsy of VII, VIII, X
Mattern et al. ³³	1980	M	R Ω	51	VIII		CR; T-VIII		Better but deaf [†]
Graves and Schemm ¹⁵	1982	M	L	26	V, VIII		IR		Neuralgia better but deaf
Rosenbloom et al. ¹⁹	1985	M	L	28	V, VII, VIII-v		IR		Severe hearing loss
Steimle et al. ³¹	1985	M	L	44	VIII		IR		Deaf, palsy of VII, X
Christensen et al. ¹³	1986	M	R	61	0		AU		Autopsy case
		F	L	41	VIII, V		IR		Palsy of VII, VIII-X
		M	L	28	VII, VIII-v, V		IR		Deaf, severe vertigo
Dalley et al. ²⁸	1986	F	L	55	VII, VIII		CR?		Palsy VII, deaf
Pensak et al. ¹⁷	1986	M	R	43	VIII		IR		Deaf, tinnitus
Levin and Lee ³⁶	1987	F	L	49	VIII		IR		Deaf/palsy VI, VII, XI-XII
Nakao et al. ³⁷	1988	M	L	22	VII		BX; T-VIII		Vertigo better but deaf
Heiss et al. ³⁰	1988	M	L	38	V, VIII		IR		Facial spasm better
Nishizawa et al. ¹⁶	1990	M	L	48	0		IR		Unchanged
Truwitt and Barkovich ⁴	1990	NM	L	38	VIII		IR		Unchanged
		NM	L	NM	NM		NM		NM
		NM	L	NM	NM		NM		NM
		NM	R	NM	NM		BX		NM
		NM	L Ω	NM	NM		NM		NM
Cohen et al. ¹⁴	1992	F	L Ω	30	VIII-v		BX		Better
Present case	1996	F	R	50	VIII		IR		Unchanged

M, male; F, female; R, right; L, left; CN, cranial nerves; I-XII, cranial nerves I to XII; CR, complete removal; IR, incomplete removal; T-VIII, transection of VIII cranial nerve; BX, biopsy; AU, autopsy; Ω, intracranial; VIII-v, vestibular nerve; NM, not mentioned; 0, none.

*Incomplete spina bifida present.

[†]Translabyrinthine approach.

[‡]Cranial nerve seen on MRI within lipoma.

grossly displaced, as in the case of a neoplastic lesion. CPA lesions typically relate to the pontomedullary sulcus. *Meninx primitiva* may be trapped at this site of neural tube flexion, and a lipoma is formed around the contents of the CPA cistern. Our analysis showed that at least the VIII nerve was incorporated and running through the lipoma in all cases that were explored surgically or at autopsy.

Furthermore, the lesions occurred predominantly on the left side (24 versus 6) and in male patients (16 versus 8). Our patient's combination of a right-sided lipoma in a female is the second reported case. A sex or side preference is not evident from reviews on intracranial lipomas in general.^{2,10,26} However, we found as well a ratio of 8 versus 3 in favor of the left side when reviewing eight lipomas in the silvian fissure and three located laterally over the cerebral convexity.^{2,10,27} This demonstrates that supra- and infratentorial lipomas lateral to the midline are predominantly found on the left side.

Histology

In our patient, histology showed mature adipose tissue with numerous incorporated single nerve fascicles as well as arteries and veins. Similar descriptions are given in most reports on CPA lipomas.^{15,19,28–31} Furthermore, Christensen et al¹³ and Winther and Reske-Nielsen³² described entrapped nerve fibers that seemed to be spread apart by the adipose tissue. In intracanalicular lipomas of the internal auditory canal, this histopathological picture was so pronounced that the lesion was once called *intraneural lipoma*.^{14,33,34}

The fact that single nerve fascicles are located within the macroscopically normal-looking adipose tissue around the cranial nerves is of major importance because any dissection of adipose tissue may damage functional important axons. This explains the high frequency of cranial nerve damage when a surgical removal of the lipoma was attempted. In other words, this histopathological feature is a serious limitation for any surgical intervention.

Clinical Presentation

To our knowledge, neither neoplastic cell features nor visible growth in control CT or MRI scans have been observed. Lipomas do not seem to enlarge significantly, and this correlates well with clinical symptoms: In most patients they developed slowly and progressively over years. Two of three cases in which an absence of symptoms is mentioned were autopsy cases.^{13,35} The third was deaf on the lesion side due to an infection in early childhood.³⁰ All other patients but one had symptoms of VIII nerve involvement like vertigo, dizziness, unsteadiness, tinnitus, and hearing loss. In one pa-

tient with hemifacial spasm a loop of the labyrinthine artery was pushed against the facial nerve by a lipoma.³⁶ Four patients presented with mild facial sensory impairment^{13,19,37} and two with trigeminal neuralgia.^{1,15} Mild facial nerve weakness was reported in three patients.^{13,19} Although intraoperatively an involvement of the lower cranial nerves was seen in 10 patients, none of these had corresponding symptoms.^{13,15–17,19,28,29,32} This supports the hypothesis that the minimally or nongrowing lipomas rather cause their symptoms by long-standing irritation of the more susceptible nerves V and VIII than by direct damage of nerve fibers.

Radiological Findings

CT and MRI imaging techniques enable preoperative discovery and identification of lipomas. Except for incorporated vessels, nerve fibers, and strands of connective tissue, the lipoma is mainly composed of fat cells. In both imaging techniques fat has a very characteristic appearance.

CT scans show a very low density mass that has attenuation characteristics similar to adipose tissue (–50 to –100 HU).^{9,22} The attenuation is below cerebrospinal fluid but above air, and an uptake of contrast medium does not occur. This characteristic finding is uniformly described for almost all CPA lipomas.^{13–17,19,30,31,36} Another typical feature is the small mass effect of the lesion compared with its size.^{17,19,31} Our observation of higher density structures inside the lesion most likely representing cranial nerves has been described before by Dalley et al.²⁸

In MRI scans lipomas appear hyperintense compared with brain on T₁ images and are characterized as fat by progressive diminution of signal intensity with increasing T₂ weighting (hypointense on standard T₂). After application of contrast medium no enhancement is seen.^{4,22} MRI scans were performed in all analyzed cases after 1986, and these characteristics are uniformly reported.^{4,14,16,30,36,37} As in the present patient, low-intensity structures inside the mass interpreted as cranial nerves had been described by others.^{4,16}

The following lesions have to be considered in the differential diagnosis: dermoid, epidermoid, and arachnoid cyst.^{19,22,38} Dermoids and epidermoids contain significant amounts of fat that can be confused with a lipoma. Arachnoid cysts and epidermoids are hypodense on CT/MRI; T₂ images, however, show cerebrospinal fluid density/intensity.^{3,8} Dermoid tumors are most likely to contain high amounts of fat and can behave in both imaging techniques similar to lipomas. However, CT attenuation is somewhat higher (–20 to –40 HU) and calcification often present. They are rarely found outside the midline and tend to rupture, giving characteristic fat droplets within the subarachnoid space. The heterogeneous density or intensity fur-

ther aids the diagnostician. Sometimes so-called white epidermoids with a higher cholesterol content can appear iso- or hyperintense to brain on T₁-weighted MRI scans. However, they usually appear heterogeneously.^{4,22,38,39}

In 1986, Pensak et al¹⁷ were the first authors to expect a lipoma preoperatively due to the striking CT characteristics. All authors after 1986 additionally employed MRI. All except one³⁶ expected preoperatively a lipoma or even established the diagnosis of lipoma according to the imaging characteristics alone.^{4,14,16,17,30} We therefore conclude that a lipoma can be diagnosed with great accuracy in a patient with slowly progressive symptoms of VIII and/or V nerve irritation if a lesion in the CPA has little mass effect, is incorporating cranial nerves, and fulfills the striking radiological criteria of fat in CT and MRI. However, the incidence in the CPA is so low (0.05%) that lipomas tend to be a once-in-a-lifetime experience for the individual neurosurgeon.

RESULTS OF SURGERY

Before the use of CT, surgery was the only way to establish diagnosis.^{32,34} Some authors using CT or CT plus MRI believed that the surgical exposure was still necessary to obtain a histological proof of the nature of the lesion.^{14,16,33} Since almost all tumors were symptomatic at the time of surgery, an indication for partial resection and decompression of the cranial nerves was seen by many. Because of the experienced tight adhesion of the lipoma to the brain stem and the incorporated structures, this recommendation was always combined with a warning of possible cranial nerve damage.^{13,14,16–19,31}

We analyzed the outcomes of all reported patients who underwent surgery (Table 1): A complete removal was only achieved in three cases of intracranial IAC lipoma.^{33,34} One patient had unchanged hearing after a middle fossa approach, but nothing is known about his other symptoms.³³ The other two are described as being well or better; however, both lost their hearing due to the translabyrinthine approach. In one case the VIII nerve was transected to achieve tumor removal.³⁴ Another patient with intracranial lipoma troubled by vertigo was better after bony decompression and biopsy.¹⁴

In all other patients only incomplete or partial lipoma removal was achieved. One patient with trigeminal neuralgia is reported to have been better for 10 months, and another was free of pain but suffered a severe hearing loss.^{1,15} The patient with facial spasm became asymptomatic without additional cranial nerve damage.³⁶ One patient troubled by severe vertigo and moderate hearing loss received VIII nerve transection, relieving the vertigo at the expense of deafness.¹⁷ The best postoperative result of the remaining 12 cases of CPA lipoma was achieved in four: an unchanged patient

without additional cranial nerve damage, including the present case.^{16,29,30} All others suffered a persistent cranial nerve damage with the minimum of deafness.^{13,17,19,28,29,31,32} A few patients were reported to be slightly better concerning headaches or vertigo. There was no mortality.

SUMMARY

CPA lipomas are very rare tumors. The patients are most likely to present with slowly progressive symptoms of VIII nerve impairment and of trigeminal irritation. These are the result of long-standing nerve affection. The lipoma has a characteristic appearance in both CT and MRI. If this exceptional lesion is considered at all in the differential diagnosis, neuroimaging alone should establish the diagnosis with sufficient accuracy. The importance of a neuroradiological establishment of diagnosis cannot be overemphasized because modern microneurosurgery does not result in a lipoma removal without causing additional cranial nerve damage and morbidity. The existence of functional axons within normal-looking fat tissue renders its removal around the cranial nerves for the purpose of decompression hazardous and is likely to produce neurological deficits.

We therefore recommend following patients with a suspected lipoma by repeat MRI to proof the absence of tumor growth. Conservative treatment options should be encouraged. There is, however, an indication for minimal surgical intervention in patients with intractable trigeminal neuralgia, facial spasm, or otherwise nonmanageable vertigo, nausea, and unsteadiness. In these cases careful nerve decompression may alleviate the symptoms.

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