Intracranial lipoma

Diagnostic and therapeutic considerations

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Eleven cases of intracranial lipoma, diagnosed during life by computerized tomography (CT) scanning, are presented. Clinical symptoms related to the lesions were present in eight. The CT scan establishes the diagnosis of intracranial lipoma on the basis of typical x-ray absorption and location. Only dermoid cysts and teratomas may produce a similar CT appearance. In cases of intracranial lipoma, a direct surgical approach is seldom necessary, although in certain locations, lipomas may cause blockage of cerebrospinal fluid pathways and require a shunt operation.

KEY WORDS • intracranial lipoma • lipoma of corpus callosum • dermoid cyst • teratoma • hydrocephalus • computerized tomography

Intracranial lipomas are very rare. Most of the reported cases have been found incidentally at postmortem examination. The majority of these developmental lesions show few or even no symptoms, and hardly ever produce alarming neurological defects. The best known variety is the lipoma of the corpus callosum, first described by von Rokitansky in 1856. On plain skull films, lipomas of the corpus callosum usually have calcification shaped like a chalice or shell at the margin of the tumor, which permits the correct diagnosis. In the anteroposterior projection, the x-ray attenuation between the calcified outer shells is often markedly diminished, a finding that can be used as an additional type-specific criterion. In early childhood the radiological diagnosis of lipoma of the corpus callosum is possible, even in the absence of calcifications, because of the higher transparency of fatty tissue. Lipomas in other locations cannot be identified as such by conventional neuroradiological methods. Nowadays, computerized tomography (CT), through exact analysis of the x-ray absorption, makes feasible the diagnosis of lipomas at any site of the intracranial space. Faerber and Wolpert have recently reported five patients with intracranial lipoma detected on the CT scan.

This report includes observations on 11 cases found within the last 4 years among 17,500 patients who were studied by CT at three university hospitals.

Clinical Material and Methods

Diagnosis of Lipoma

Knowledge of preferential locations of intracranial lipomas is an essential prerequisite for the correct interpretation of CT findings. Krainer, on the basis of published cases and observations of his own, has listed the typical locations of these rare tumors as follows: 1) ambient cistern, quadrigeminal plate/brachium conjunctivum border zone; 2) chiasmatic cistern/infundibulum; 3) interpeduncular fossa cistern; 4) Sylvian cisterns; 5) lateral pontine cistern; 6) cerebello-medullary cistern; 7) tela chorioidea of the lateral and third ventricles, choroid plexus, velum interpositum; and 8) callosal cistern. Krainer also reported five cases of lipoma of the corpus callosum in combination with small tumor nodules in the choroid plexus of both lateral ventricles.
Intracranial lipoma

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex, Age (yrs)</th>
<th>Location of Lipoma(s)</th>
<th>Computerized Tomography Findings</th>
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<td></td>
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<td>frontal inter-hemispheric fissure; callosal cistern</td>
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</table>

*Tumors are grouped according to the classification of Krainer. 13
†Number of adjacent slices in which the tumor was visible. Slice thickness: 10 or 13 mm.
‡Mean ± SD attenuation value in the tumor-bearing slices. Unless otherwise indicated, values are in Hounsfield units.
§Attenuation values were measured in EMI units with the EMI Mark I CT scanner (500 scale, 1 EMI unit = 2 Hounsfield units).

The CT diagnosis of a lipoma is based on the characteristic attenuation of these lesions. Since fatty tissue ranges around -100 Hounsfield units (in the 1000 scale), corresponding attenuation values can be expected (Table 1). However, in a smaller lipoma that does not take up the whole of one CT slice, the mean negative density is less pronounced due to the partial volume effect (see Cases 1 and 4 to 7). Contrast infusion does not produce a significant change of attenuation values.

Clinical Material

In the following case reports all CT investigations were performed with EMI head scanners; in Cases 5, 9, and 10 with the EMI Mark I (500 scale), in all other patients with the EMI CT 1010 head scanner. The CT scans were made with a window width of 100 to 200, in order to enhance the difference of density between cerebrospinal fluid (CSF) and lipoma. In most cases a window level of +20 to +30 was used.

Case Reports

Intracranial Lipomas

Eleven cases of intracranial lipoma are summarized below (Table 1).

Case 1. This 9-year-old boy suffered the onset of seizures of 30 minutes' duration. On admission, his left eye was closed. The right side of his body was "cold," the right arm was tonic in supination, with the right shoulder drawn in, and the right corner of his mouth was distorted. Neurological investigation, electroencephalogram (EEG), plain skull films, and radioisotope scan were noncontributory. The CT scan showed a hazelnut-sized lesion of very low attenuation (mean value = -48 to -52 Hounsfield units) in the left ambient cistern, which was diagnosed as lipoma (Fig. 1).

One year after the first CT investigation, the frequency of the seizures increased; they were of an identical type. The patient complained of nausea in the...
morning and frequent headaches. The CT appearance of the lipoma remained unchanged. No operation is presently contemplated.

Case 2. This 36-year-old woman had a 2-year history of occipital headache. Three weeks before hospitalization, she became unconscious for 10 minutes. A CT scan showed a hypodense lesion in the right ambient cistern near the quadrigeminal plate (Fig. 2 lower). Mean density values in different cuts ranged from −72 to −88 Hounsfield units. This lesion was initially thought to be a dermoid cyst, and the attacks of severe headache were considered to be due to aseptic meningitis secondary to penetration of keratin material into the CSF spaces. A right occipital craniotomy was performed with division of the ten-
Intracranial lipoma

Fig. 3. Case 2. Postoperative computerized tomography scans.

torium, and a yellowish tumor was visualized, that was identified as lipoma (Fig. 2 upper). The fatty tumor was excised, but a coarse fibrous membrane covering the lower colliculi was spared.

The postoperative course was uneventful. A CT scan 10 months after the operation showed no residuum of the tumor; the ambient cistern on the right was not patent (Fig. 3). Later the patient experienced a single epileptic seizure with optic aura, and was placed on anticonvulsant therapy.

Case 3. This 67-year-old man was admitted in April, 1977. He had noticed increasing spastic hemiparesis on the left side since suffering a stroke with left-sided symptomatology 5 years previously. There was angiographic evidence of a generalized cerebrovascular disorder, with variations of caliber in both larger and smaller cerebral arteries. A CT scan demonstrated a lipoma the size of a hazelnut at the quadrigeminal plate, and marked hydrocephalus (Fig. 4). Since there have been no signs of increased intracranial pressure, a shunting operation has been postponed. At follow-up examination 1 year later, the patient felt well. The CT findings were unchanged.

Fig. 4. Case 3. Lipoma of the quadrigeminal plate (arrows). Severe hydrocephalus was caused by blockage of the aqueduct by the tumor (right pair).
Case 4. This 43-year-old woman complained of progressive spasticity of all four extremities, especially of the legs. Neurological evaluation disclosed hyperactive reflexes bilaterally. Auditory evoked potentials in the EEG pointed to a functional disturbance in the upper pons or midbrain. On CT investigation, a lesion of low density (−40 Hounsfield units) was seen in the region of the velum interpositum (Fig. 5). There were no symptoms of mass effect. The lesion was believed to be a lipoma, and no operation was performed.

Case 5. This 48-year-old woman had suffered from tuberculous choroiditis in 1943. An enlarged sella was detected in 1975. On admission she had severe visual deficits (1/35 bilaterally), and incipient temporal pallor. On CT scanning, an area of very low density (−81 Hounsfield units), 20 mm in diameter, was revealed in the supra- and retrosellar space with extension to the interpeduncular fossa. Angiography showed elevation and dorsal displacement of the basilar artery without pathological vascularization. The patient refused operation because it was not certain that the loss of vision had occurred as a result of the lipoma.

Case 6. In 1973, this 12-year-old boy had suffered severe injury with brain concussion and lost consciousness for 10 minutes. He had rupture of the spleen, liver laceration, and fracture of the femur. Since early in 1976, he had shown increasing aggressiveness. An EEG recorded dysrhythmia, and abnormal theta waves frontally. Skull films, radioisotope scan, and ophthalmological investigation were normal except for a red-green blindness. ACT scan showed a small hypodense lesion (−42 Hounsfield units) within the chiasmatic cistern (Fig. 6); this lesion was thought to be a lipoma. The patient’s aggressiveness increased, but there was no neurological deficit. The lipoma was considered an incidental finding and no operation was performed.

Case 7. This 60-year-old man was admitted for evaluation of a severe psycho-organic syndrome consisting of disorientation, intermittent confusion, increasing deterioration of vision, vertigo, and micturition disturbance. On examination, several small pedunculated cutaneous tumors were noted on his neck and back. He had papilledema on the left, but his vision could not be fully evaluated since he was uncooperative. He exhibited unsteadiness in walking and dysmetria.

A CT scan revealed tumor nodules of extremely low attenuation in the choroid plexus of both lateral ventricles, extending to the foramen of Monro (Fig. 7 upper right pair). There was occlusion of the lateral ventricles with extreme dilatation of the temporal and occipital horns. An area of hypodensity surrounded the ventricles, possibly due to transependymal CSF resorption. A diagnosis of multiple plexus lipomas was made on the basis of site and density of the nodules. Additional small lipomas were seen in the ambient cistern on the left, in the anterior portion of the third ventricle, and the interpeduncular fossa (Fig. 7 upper left pair and lower left). A shunt with Y drainage was placed, and the patient’s psycho-organic syndrome, vertigo, and visual disturbances resolved immediately. His bladder function returned to normal. At follow-up examination, CT showed marked regression of the ventricular enlargement; the periventricular hypodense areas were no longer visible (Fig. 7 lower right).

Case 8. This 21-year-old woman had complained of psychomotor seizures for 2 years. For 3 months before admission she had suffered headache. X-ray examination revealed intracranial shell-like calcifications of the midline region of the skull. A CT scan showed multiple low-density tumors of the corpus callosum lying within both lateral ventricles. The CT scan with attenuation measurements established the diagnosis of...
Intracranial lipoma

FIG. 7. Case 7. Multiple intracranial lipomas. **Upper:** Small lipoma in left part of ambient cistern (arrow, left slice), small lipoma in the anterior portion of the third ventricle (arrow, center left slice), small lipomas at the choroid plexus of both lateral ventricles near the foramen of Monro (arrows, center right slice), and lipomas in the glomus of the choroid plexus bilaterally, causing occlusion of the lateral ventricles (right slice). Extreme dilatation of the temporal and occipital horns and periventricular hypodensity as a sign of transependymal cerebrospinal fluid penetration can be seen. **Lower Left:** Small lipoma in interpeduncular fossa (CT picture reversed in order to demonstrate the lesion more clearly). **Lower Right:** Marked regression of ventricular width 6 weeks after drainage operation (artifacts from metal parts of the valve).

lipoma of the corpus callosum in combination with lipomas of the choroid plexus of both lateral ventricles (Fig. 8 left pair). There was marked dilatation of the temporal and occipital horns due to blockage of the CSF pathways by the plexus lipomas. As the intermittent headaches were thought to be due to hydrocephalus, a shunt with Y drainage was inserted. The patient's headaches ceased after the operation, and at CT control 1 week later, significant reduction of the occipital horns was seen (Fig. 8 right pair).

Case 9. This 20-year-old man had experienced generalized seizures for 4 weeks before admission. The

FIG. 8. Case 8. Combination of lipoma of the corpus callosum and lipomas of the choroid plexus of both lateral ventricles. **Left Pair:** Marked dilatation of the occipital horns. There is agenesis of the corpus callosum. **Right Pair:** After shunt operation with insertion of ventricular catheter bilaterally from occipital burr holes, there is a significant reduction of ventricular size. The catheter tips are visible on both sides.
Fig. 9. Case 9. Typical lipoma of the corpus callosum lying between the cerebral hemispheres. The left three scans show shell-like calcifications at the margin of the tumor. There is agenesis of the corpus callosum with considerable separation of the lateral ventricles. Right: Follow-up study after partial removal of the lipoma. The isodense part within the lipoma is probably scar tissue.

CT scan demonstrated a lipoma of the corpus callosum that showed the typical calcifications at the edge of the tumor (Fig. 9 left three scans) and a very low density (−51 to −55 EMI units) in the center. At operation, a solid yellowish tumor was found (Fig. 10), which could be removed only partially because of dense fibrous connections to the brain surface and both pericallosal arteries. There was also a focus of very dense connective tissue within the center of the fatty tumor. Postoperative CT scans demonstrated reduction in the size of the lipoma (Fig. 9 right). The postoperative course was uneventful, and the patient continues on anticonvulsivc therapy.

Case 10. This 59-year-old woman showed abnormal behavior 6 months before hospitalization, and suffered generalized seizures 3 months later. There was an EEG focus in the right frontal area. Typical calcifications on plain skull films indicated a lipoma of the corpus callosum, and this diagnosis was confirmed by CT scanning. A lipoma, 30 × 35 mm in diameter, was revealed; it had extremely low density (−54 EMI units) in the center and calcified shells at the edge. The tumor was partially removed, and the specimen was verified histologically as a lipoma. The postoperative course was uneventful.

Fig. 10. Case 9. View of the lipoma through the operating microscope, approached through the right side of the interhemispheric fissure. The right pericallosal artery is seen in front of the spatula. The vascularized tumor capsule can be seen.
Intracranial lipoma

Case 11. This 9-month-old baby had been operated on for a right frontal encephalocele on his 7th day of life (June 23, 1977). Thereafter, his head circumference increased, and a shunt was inserted on August 11, 1977. His head size increased further, but there were no neurological deficits. His mental and motor development corresponded to his age. Skull films showed sprung sutures in the right frontal region, brachycephalus, and postshunt status. A CT scan revealed a lobulated mass of extremely low density (−96.5 to −125 Hounsfield units) within the interhemispheric fissure between the frontal lobes. The tumor was diagnosed as a lipoma (Fig. 11). At operation on April 4, 1978, the tumor was found to originate from the corpus callosum. The mass was enucleated and the diagnosis of lipoma was verified by histological examination.

Differential Diagnosis on CT Scanning

Apart from lipomas, there are some other developmental tumors that attract attention because of their very low x-ray attenuation resulting in CT pictures similar to those of lipomas. These include dermoid cysts (as teratoid tumors) and teratomas. Since the introduction of CT scanning at our hospitals, four patients with intracranial tumors of these types have been observed. The characteristic findings are reported below.

Case 12. This 40-year-old patient underwent CT examination because of occasional generalized epileptic seizures. The scan showed a cystic lesion in the left frontal lobe extending from the sphenoid bone near the olfactory groove (Fig. 12 upper), with extremely low attenuation (−61 EMI units). The density differences within the lesion were remarkable (Fig. 12 lower). At operation a tumor containing keratinic masses and hairs was found, surrounded by a strongly refracting oily fluid; the lesion originated from an excavation in front of the sphenoid ridge. The histological diagnosis was dermoid cyst.

Case 13. This 36-year-old patient had complained of intermittent headache for several years. A CT scan revealed a cystic lesion of very low attenuation (mean density −68 Hounsfield units) in the right frontal lobe, extending from the olfactory groove in front of the sphenoid ridge (Fig. 13 left pair). The characteristic bone defect is clearly visible in the coronal CT picture (Fig. 13 right pair). This lesion had been diagnosed from the start as a dermoid cyst because of its low absorption and site. There was a small area of calcification at the posterior aspect of the lesion. Aplasia of the cerebellar vermis was noted as an additional anomaly. At operation a tumor containing keratinic masses and hairs was found. The histological diagnosis was dermoid cyst.

Case 14. This 32-year-old patient had been treated for multiple sclerosis for several years because of visual disturbances. Five years before the present admission, a Torkildsen procedure was performed for hydrocephalus. On examination, the patient had visual deficits and deterioration of general condition. The CT scans showed a large cystic midline lesion of extremely low attenuation (mean absorption −35 EMI units on a 500 scale), with delicate calcifications at the edge of the tumor (Fig. 14). There was massive occlusive hydrocephalus. At operation, a tumor consisting of keratinic masses and hairs was removed, leaving behind parts of the tumor capsule attached to the floor of the third ventricle. Histological study confirmed the diagnosis of a dermoid cyst.

Case 15. In this 8-year-old boy an “inoperable”
tumor within the third ventricle had been diagnosed by positive ventriculography 3 years previously. A ventriculoatrial shunt was inserted at that time. At a routine follow-up examination a CT scan demonstrated a non-homogeneous lesion, $50 \times 38$ mm in size and of very low attenuation (mean density $-37$ EMI units), within the third ventricle. From the CT appearance a dermoid cyst was diagnosed. The tumor was totally removed via a right occipital approach. The encapsulated lesion consisted mainly of keratinic masses with isolated hairs, but connective tissue could also be seen macroscopically. The histological ex-

**FIG. 12.** Case 12. Dermoid cyst originating from the olfactory groove (arrows) and extending to the left frontal area. *Upper:* The computerized tomography appearance is similar to that of intracranial lipomas due to the very low density. *Lower:* At low window levels ($-10$ to $-30$ Hounsfield units) the non-homogeneous nature of the lesion is clearly visible.

**FIG. 13.** Dermoid cyst in the right frontal region. *Left Pair:* A circular low-density lesion can be seen with delicate calcification at the edge of the cyst. There is concomitant aplasia of the cerebellar vermis. *Right Pair:* Coronal scans show the defect in the right olfactory groove in front of the sphenoidal jugum (arrow) with the cyst extending into the frontal lobe.
Intraeranial lipoma

**FIG. 14. Case 14. Dermoid cyst within the third ventricle with a small area of calcification. This patient has severe hydrocephalus.**

amination revealed endodermal tissue; therefore, the final diagnosis was teratoma.

**Discussion**

The rarity of intracranial lipomas is indicated by the fact that in a series of 3200 patients with brain tumors studied by CT during the last 4 years at the university clinics in Munich, Mainz, and Berlin, only 11 cases of lipoma were found (0.34%). When the number of lipomas is related to all 17,500 patients examined by CT during this period of time, the incidence is reduced to 0.06%. This figure corresponds exactly to the report of Vonderahe and Niemer who discovered four lipomas among 5000 postmortem examinations. On the other hand, Budka found nine patients with lipoma among 1956 selected neuropathological autopsied cases, for an incidence of 0.46%.

Lipomas are most frequently located in the region of the corpus callosum. Other preferential sites are the region of the tuber cinereum, the quadrigeminal plate, and the ambient cistern.

Intracranial lipomas are heterotopic lesions caused by malformation, and should be separated from true tumors, such as hamartomas. As "superfluous tumor-like masses of improperly blended tissue" they are akin to teratoid and teratomatous anomalies. They grow as part of the general growth of the body, unlike tumors of the ventricle walls in tuberous sclerosis or neurofibromas, for example. Clinical progress, therefore, in a case of intracranial lipoma is hardly ever secondary to tumor growth and much more frequently due to involvement of the surrounding structures into regressive changes within the lipoma tissue.

Until a few years ago the majority of intracranial lipomas were found incidentally at postmortem ex-aminations. Lipomas with neurological focal symptoms have been rare, according to the older literature. Recent reports on the other hand, show that intracranial lipomas may cause numerous nonspecific signs and symptoms. Eight of our 11 patients presented with symptoms that could be considered directly or indirectly related to the intracranial lipoma.

Since the introduction of CT, unexpected findings of intracranial lipomas have increased. The CT appearance of lipomas of the corpus callosum was first described by New and Scott in 1975. The area of low density in the center of their tumor, and the typical calcified shells covering it, showed attenuation values identical to fat (−50 EMI units, and −100 Hounsfield units, respectively). Other individual reports of lipomas diagnosed by CT have been published by Wallace and by Tahmouresie, et al. Faerber and Wolpert have recently reported on five intracranial lipomas detected by CT scanning. There was no histological verification. In their Case 4 we consider epidermoid or dermoid cyst as the most probable diagnosis.

The proportion of children was very high in these reports. Our series contains three children; two other patients were aged 20 and 21 years at the time of diagnosis. On the other hand, Matson found only one child with an intracranial lipoma in a series of 750 brain tumors in children.

Lipomas causing occlusive hydrocephalus require special attention. Whereas the hydrocephalus in Case 3 with lipoma of the quadrigeminal plate could be considered as compensated, the lipomas in the choroid plexus of the lateral ventricles in Cases 7 and 8 had caused partial hydrocephalus with signs of increased intracranial pressure. This was particularly pronounced in Case 7, with excessive dilatation of the temporal and occipital horns. The patient recovered completely within a few days after the insertion of a bilateral ventriculoatrial shunt.

In the older neuropathological literature there are several case reports of lipomas of the choroid plexus within the lateral ventricles, sometimes combined with lipoma of the corpus callosum. Henschen's case of a 27-year-old epileptic woman with symmetrical lipomas in combination with a large lipoma of the corpus callosum is a striking parallel to our Cases 7 and 8. Two other reports with similar CT findings suggest that in these patients, too, bilateral choroid plexus lipomas might have been present in addition to lipoma of the corpus callosum. The authors discuss whether the symmetrical posterior components of the corpus callosum lipoma represent separate masses; the marked, predominantly left-sided dilatation of the posterior horns in Wallace's Case 2, and the excessive enlargement of both occipital horns in the case described by Tahmouresie, et al. seem to us indicative of this possibility. In such patients, a shunting procedure should be the treatment of choice.
However, in contrast to our experience, the patient reported by Tahmouresie, et al., showed only minimal improvement after the operation.

A direct surgical approach is only rarely indicated in the case of intracranial lipoma. Complete removal of a lipoma of the corpus callosum is impossible as a rule, because the fatty tissue is extremely well vascularized and is interspersed with fibrous tissue that covers the pericallosal arteries and its branches. In our experience, preservation of all these vessels is not possible even when using microsurgical technique. The only case in which it is stated explicitly that the tumor has been totally removed with definite improvement was that of Groff, et al. In the opinion of the authors, the tumor can be extirpated successfully so long as care is taken not to enter the third ventricle.

Since lipomas of the corpus callosum in most cases are combined with a partial or complete agenesis of the corpus callosum, as shown in earlier cases by neuropathological investigations and now by CT studies, it is hardly possible not to enter the third ventricle during removal of the lipoma.

It is questionable whether a lipoma of the corpus callosum should be considered as a space-occupying intracranial lesion that requires removal. Epileptic seizures, present in about 50% of these patients, cannot be cured by the operation. The same is true for the majority of lipomas in other locations which only rarely attain a size sufficient to cause a life-threatening increase of intracranial pressure. We decided to operate in Case 2 because we had erroneously diagnosed a dermoid cyst with aseptic meningitis, secondary to penetration of epidermal material into the CSF spaces. This tumor contained a high proportion of connective tissue which complicated the operation and precluded excision of the fibrous capsule at the lower colliculi on the right. However, the trochlear nerve was preserved. This case brings up the question of differential diagnosis between lipoma and teratoid tumor, since dermoid cysts and teratomas may produce CT pictures with similar attenuation values, and are about as infrequent as lipomas. Our experience is correspondingly restricted. Epidermoid cysts, which are much more frequent, mostly display the density of CSF. Three locations, however, are preferential sites of dermoid cysts and teratomas: the third ventricle, invaded from the region of the pineal body, the subfrontal region, and the subtemporal area originating from the sphenoid bone. As far as we know, no unequivocal case of lipoma has been described in the latter regions. Apart from the location, the non-homogeneous nature of the hypodense contents of dermoid cysts may help in the differential diagnosis on the CT scan (Fig. 12 lower). Histograms of lipomas show homogeneous attenuation values with small standard deviation if the tumor has a diameter of at least 25 to 30 mm (Fig. 15). In smaller lipomas, the standard deviation is increased due to the partial volume effect (see Table 1). All dermoid cysts we could evaluate exceeded the above-mentioned...
Intracranial lipoma

minimum diameter and still had a standard deviation of at least 20 Hounsfield units.

Further experience will show whether the correct cytological diagnosis of lipomas and other malformative tumors can be made in all cases through applying the criteria of x-ray attenuation, standard deviation of absorption figures, and preferential site of such lesions.

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