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Intracranial lipomas: Clinical and radiological analysis of 153 cases and review of the literature

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Abstract
Aim: It is aimed to describe the localization distribution of lipomas in cases diagnosed with intracranial lipoma, HU value measurements in CT examinations, and point value measurements in MRI and discuss them in the light of the literature.
Material and Methods: Cases diagnosed with intracranial lipoma were recorded retrospectively by scanning the radiology database and polyclinic records. The localization of the lipomas was recorded by measuring the HU value on CT imaging and spot value measurements on MRI T2 sequence imaging. The same data were recorded and compared in control radiological examinations.
Results: A total of 153 cases were diagnosed with intracranial lipoma, and falx lipoma (n:72) was the most common. Intra-calvarial lipoma, which was not defined in the literature, was detected in 21 cases. In CT examinations, the mean HU value at the time of initial diagnosis was -57.91 ± -12.81; In the examination of MRI T2 sequences, it was recorded as 1384.23 ± 101.62. In control radiological examinations, no statistically significant difference was detected between HU values in CT examinations and point values in MRI examinations.
Discussion: It was determined that intracranial lipomas did not differ in their quantitative radiological examinations. Epilepsy resistance to medical treatment is observed in almost all cortical lipomas. Association with central nervous system anomalies is seen only with callosal lipomas.

Keywords
Intracranial Lipoma, HU Value, Hounsfield Unit, Lipoma

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Introduction

Intracranial lipomas are very rare, usually asymptomatic, and often detected incidentally. They are detected in 0.1% to 0.5% of all intracranial space-occupying lesions [1]. They are considered congenital malformations after abnormal differentiation of the meninges primitiva and are not considered true neoplasms [2]. They are frequently seen with central nervous system anomalies such as corpus callosum agenesis, spina bifida, and cortical malformations [3,4]. Although they are frequently located cisternally, they can rarely be located on the surface of the cerebral hemispheres [5,6]. It is recommended that they be treated conservatively as much as possible since surgical interventions are high-risk and the complication rate is high in symptomatic cases due to their tight adhesion to the adjacent tissues [7].

Although radiological examinations are typical, they show similar features in qualitative evaluations in computed tomography (CT) examinations [8]. Quantitative differential diagnosis can be made with Hounsfield Unit (HU) value measurements in CT examinations, and HU values are in the range of -30 - -130 [9]. Magnetic Resonance Imaging (MRI) examinations are seen as high-signal on T2-weighted images and low-signal on fat-suppressed T1-weighted images and do not show contrast enhancement [8,10].

Material and Methods

Cases who applied to our institution between 2013-2021 and were found to have intracranial lipoma after radiological examinations were identified. For this purpose, cranial CT and MRI images of cases with intracranial lipoma were obtained by scanning the radiological database of the institution. Demographic data of the cases were obtained by retrospectively examining the polyclinic records. Demographic and radiological data of the cases were recorded by creating a database in an Excel file.

Localizations of lipomas were determined in CT and MRI examinations, and were divided into groups. Cases according to the localization of lipomas, falx, convexity, cisternal, calvarial, pericallosal, and choroid plexus localized groups were recorded. In order to make the differential diagnosis of intracranial lipomas from other structures, HU values were measured in CT examinations. The highest HU values obtained at the central and peripheral points of the lesion were recorded. The same values were compared in the control CT examinations. In cases followed by MRI examination, point measurements were made over the Picture Archiving and Communication Systems (PACS) instead of HU value measurements and compared. In MRI images, point measurement values were performed on the images in the T2 sequence.

In cases with cisternally located lipoma, their potential to cause ventricular dilatation was evaluated using the Ewans score.

Ethics Committee approval for this study was retrieved from Kirsehir Ahi Evran University Clinical Studies Ethics Committee. File No: 20-17-13/143. Due to the study's retrospective nature, informed consent was not obtained from all the cases.

Statistical Analyses:

All the data were tabulated in Microsoft Excel 2007 data sheet with proper headings. Data were expressed as Mean and Standard deviation (SD) for continuous variables. For categorical variables, the data were represented as count and percentage. The comparison of means between the two groups was done using Student's 't-test, provided the data is normally distributed; otherwise, the Mann-Whitney' U' test was used. Comparison of categorical variables was performed using the Chi-square test. P <0.05 is considered significant. Statistical analysis was done using IBM SPSS20.0.

Results

A total of 153 cases matching the study criteria were identified. The mean age of the cases was 24.27±10.10 years, 97 cases were female, and 56 cases were male. Headache (n:37; 24.18%) and dizziness (n:25, 16.33%) were recorded as the most common presenting symptoms in symptomatic cases; 91 (59.48%) cases were diagnosed incidentally, and 88 (57.52%) cases were diagnosed as intracranial lipoma after cranial CT examination after head trauma. Three cases were followed up with the diagnosis of epilepsy resistant to medical treatment and were followed up due to convexity localized lipoma. The demographic distribution of the cases is shown in Table 1.

The most common lipoma in the falx (n:72, 47,06%) was determined when evaluated according to their localization. Pericallosal lipoma was detected in 9 (5,88%) cases (Figure 1). Cisternally located lipoma was detected in 42 (27,45%) cases (Figure 2,3). In 21 (13,73%) cases, a lipoma was detected in the calvarium. The distribution of lipomas according to their localization is shown in Table 2.

In 81 cases evaluated with CT examination at two different times, the mean HU value in the first CT examination was determined as -57.91 ± -12.81. In control ct examinations, the mean HU value was determined as -53.92 ± -12.75, and no statistically significant difference was found between the two groups (p:0,089). The mean control CT examination evaluation period was 22.08 ± 7.02 months. The point value was 1416.96 ± 95.82 in the first MRI examination of 90 cases evaluated by MRI and 1384.23 ± 101.62 in the control MRI examination. No statistical difference in point value was detected in the radiological examinations of these cases. The mean follow-up

Table 1. Distribution of intracranial lipomas localizations, HU and point value ranges by location (HU and point values were recorded according to the first radiological imaging. CT: computed tomography, MRI: magnetic resonance imaging)

		HU Range (CT)	Point value range MRI-T2
		(n:106)	(n: 117)
Falx	72 (-47,06%)	-56,60 ± -13,26 (n:46)	1413,12 ± 103,47 (n:54)
Cisternal/Ventricular	42 (-27,45%)	-57,97 ± -12,91 (n:31)	1402,21 ± 112,65 (n:29)
Cortical / Convexity	3 (-1,96%)	X – X	1290,83 ± 45,28 (n:3)
Calvarium	21 (-13,72%)	-55,08 ± -7,07 n:18	1428,38 ± 114,89 n:16
Corpus Callosum	9 (-5,88%)	-61,67 ± -11,99 n:6	1427,50 ± 137,75 n:9
Choroid Plexus	6 (-3,92%)	-56,15 ± -2,77 n:5	1349,17 ± 107,18 n:6
Total	153	-57,01 ± -11,85 (n:106)	1407,19 ± 110,19 (n:117)

Table 2. HU values in CT examinations in subjects with control imaging examination; Point value comparisons are shown in MRI T2 examinations. (HU: Hounsfield unit, CT: computed tomography, MRI: magnetic resonance imaging)

		Average HU (First CT)	Average HU (Control CT)	Average Point Value (First MRI)	Average Point Value (Control MRI)
Falx	72	-56,83 ± -13,83	-52,44 ± -12,63	1407,63 ± 125,68	1413,59 ± 123,00
Cisternal/Ventricular	42	-58,47 ± -10,75	-55,35 ± -12,38	1425,54 ± 81,99	1401,40 ± 83,82
Cortical / Convexity	3	-	-	1420,67 ± 104,00	1375,00 ± 55,75
Calvarium	21	-60,11 ± -12,53	-54,94 ± -12,63	1403,33 ± 90,85	1327,08 ± 82,54
Corpus Callosum	9	-57,75 ± -6,01	-49,25 ± -26,52	1443,06 ± 78,04	1364,72 ± 94,40
Choroid Plexus	6	-56,00 ± -24,04	-68,25 ± -1,77	1379,75 ± 48,31	1261,13 ± 44,44
Average		-45,1	-53,92 ± -12,75	1416,96 ± 95,82	1384,23 ± 101,62
Total	153	81		90	

Table 3. Comparative results of different series according to localization of lipomas (* Total numbers of lipomas located adjacent to the falx and pericallosal are given)

	Falx	Cisternal	Callosal	Cortical	Choroid Plexus	intraventricular	Sylvian	Others
Kelesoglu et al. n=57 (19)	26	16	10		2	0	2	1
Truwit et al. n=44 (4)	16	22	0		1	2	2	1
Yildiz et al. n=24 (11)	6	8	5		2		3	
Yilmaz et al. n=14 (20)		10	3					1
Seidl et al. n=17 (8)	6	9	1	1				
Gokduman et al. n=8 (-17)		5	3					
This Study	28	15	4	2	2	1	1	
Total	82/217 (-37,80%)	85/217 (-39,20%)	26/217 (-11,90%)	3/217 (-1,30%)	7/217 (-3,20%)	3/217 (-1,30%)	8/217 (-3,60%)	3/217 (-1,30%)

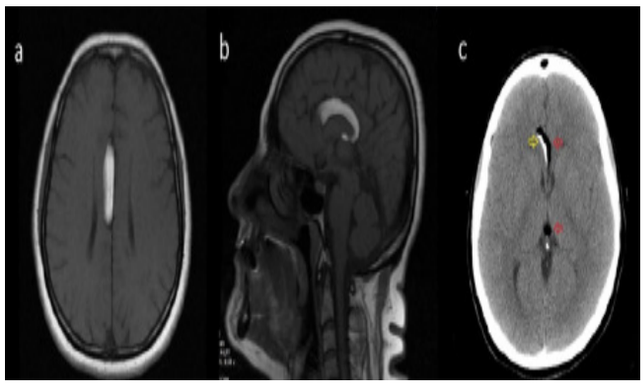

Figure 1. Callosal agenesis is seen in a pericallosal lipoma case (a and b). The calcified area of the lipoma can be evaluated on CT examination(c).

period was calculated as 17.49 ± 5.88 months. HU and point average values according to their localization are shown in Table 2.

There was no statistically significant difference in Ewan's scores after CT and MRI examinations of cases with cisternally located lipoma. However, over 13% of Ewan's score changes were detected in the evaluations of the cases. Ewan's score increased by 12 (7,8%) cases and decreased by 8 (5,2%) cases. Comparative results of different series according to localization of lipomas are shown in Table 3.

Discussion

Intracerebral lipomas are benign formations that are rarely detected. They are thought to arise due to abnormal

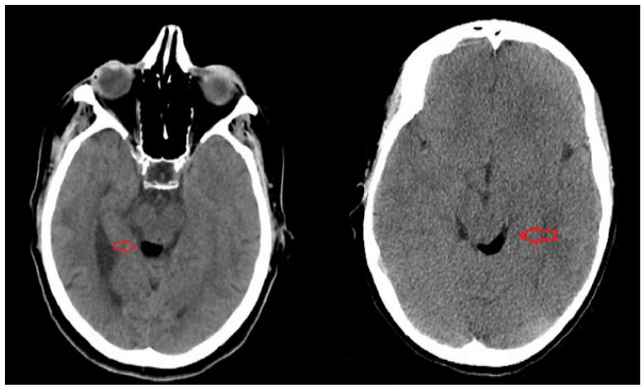

Figure 2. Cisternally located lipomas are among the most common lipomas. They may require radiological follow-up as they may cause communicating hydrocephalus.

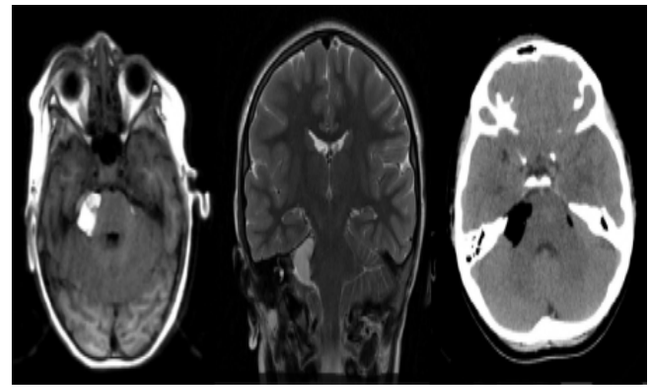

Figure 3. It is seen that the lipoma located in the cisterna at the Ponto-mesencephalic junction has a partial compression effect on the brain stem.

development and differentiation of the meninges primitiva in the Subarachnoid cisterns. They are most commonly detected adjacent to the midline structures of the brain or inside the cisternae [5,6,11]. They are generally asymptomatic formations and are frequently detected incidentally [12,13]. The radiological findings are typical, and it is not difficult to make a differential diagnosis with different formations radiologically. It is known that they do not enhance contrast in radiological examinations with contrast [14]. In some lipomas, the presence of calcified areas that can be detected more easily on computed tomography can be demonstrated [15].

Intracranial lipomas are formations detected concerning the subarachnoid space and are often adjacent to the structures in the midline [16]. Regarding lipomas considered to be benign, no case of lipoma showing parenchymal invasion or detected within the parenchyma has been encountered in the series in the literature. Rarely cases of atypically located lipoma far from the midline have been reported. It has been determined that approximately half of the corpus callosum lipomas are associated with callosal agenesis [17,18]. It has been reported that lipomas with a soft consistency adhere tightly to the surrounding tissues, and surgical complication rates are high in these cases [7]. For this reason, conservative treatment methods are recommended as much as possible in symptomatic cases [7]. It is known that epileptic seizures are most frequently encountered in extra-axial and sylvian localization [3].

Cisternally located lipoma was detected in 42 of the 153 cases evaluated, and when compared with the series in the literature, proportional differences are striking. When the studies in the literature are evaluated, it is noteworthy that the localization rates show significant differences. The lack of large series with many cases related to intracranial lipomas may explain this difference. When all series are taken into account, it is noteworthy that lipomas are mainly located adjacent to the falx or cisternal.

Calvarial lipoma cases that were not defined in previous studies were detected in 21 (13,72%) cases in this study. The HU value average of the structures described as calvarial lipomas was -55.08 ± -7.07, and when their differential diagnosis was made radiologically, they were found to be lipomas.

It was determined that there was no statistically significant difference in HU values in 81 cases evaluated with CT examinations (p:0,089). This finding supports that lipomas do not undergo physiological and anatomical changes over time. For this reason, it may not be necessary to follow up radiologically in diagnosed cases. However, in cisternal located lipomas, the potential to cause communicating type ventricular dilatation can be considered due to its effects on CSF flow pathways, even if no dimensional change has occurred.

It was noted that there were frequently recurrent epileptic seizures and multiple antiepileptic uses in all 3 cases with localized cortical lipoma. It has been reported that patients with localized cortical lipoma have a very high incidence of epileptic seizures. Although they do not show a significant mass effect, it is known that cortically localized lipomas form a high rate of epileptic focus on cortical surfaces. In these cases, surgical intervention is not recommended to eliminate the epileptic seizure focus. It has been reported that surgical intervention in lipomas with highly adhesive properties can lead to high surgical complications and morbidity. In these cases, it is recommended to continue antiepileptic therapy, including polypharmacy, despite resistant epilepsy.

Although it has been reported that central nervous system anomalies are frequently seen in cases with intracranial lipoma [19,20], these data should not be considered valid for all cases of intracranial lipoma. Except for callosal localized lipomas, no central nervous system anomaly was detected in any cases. In pericallosal lipoma cases, callosal agenesis was detected at a rate of 77,78% (n:7), and cognitive impairment was detected in these cases as a clinical finding. No significant mass effect was observed in cisternal or falx adjacent lipomas.

Conclusions:

Intracranial lipomas are formations seen approximately two times more frequently in women, and are mostly asymptomatic and detected incidentally. They are most commonly detected in falx, cisternal and pericallosal locations. Since no change in HU value was detected in the cases followed up with CT examinations, it is thought that they did not undergo any structural changes. Cisternally located lipomas may have the potential to cause communicative ventricular dilatation.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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