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Intracranial physiological calcifications in adults on computed tomography in Tabriz, Iran

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Intracranial physiological calcifications are unaccompanied by any evidence of disease and have no demonstrable pathological cause. They are often due to calcium and sometimes iron deposition in the blood vessels of different structures of the brain. Computed tomography (CT) is the most sensitive means of detection of these calcifications. The aim of this study was the assessment of intracranial physiological calcifications in adults. We studied 1569 cases ranging in age from 15 to 85 in Tabriz Imam Khomeini Hospital, Iran. These patients had a history of head trauma and their CT scan did not show any evidence of pathological findings. The structures evaluated consisted of (A) the pineal gland, (B) the choroid plexus, (C) the habenula, (D) the basal ganglia, (E) the tentorium cerebelli, sagittal sinus and falx cerebri, (F) vessels and (G) lens and other structures which could be calcified. Of the 1569 subjects, 71.0% had pineal calcification, 66.2% had choroid plexus calcification, 20.1% had habenular calcification, 7.3% had tentorium cerebelli, sagittal sinus or falx cerebri calcifications, 6.6% had vascular calcification, 0.8% had basal ganglia calcification and 0.9% had lens and other non-defined calcifications. In general, the frequency of intracranial physiological calcifications was greater in men than in women. All types of calcification increased at older ages except for lens and other non-defined calcifications. We evaluated all the cranial structures and determined percentages for all types of intracranial physiological calcification. These statistics can be used for comparing physiological and pathological intracranial calcifications. Moreover, these statistics may be of interest from the clinical perspective and are potentially of clinical use.

Key words: brain; deposition; calcium; radiological imaging

INTRODUCTION

Intracranial calcifications are often due to calcium and sometimes iron deposition in the blood vessels of different structures of the brain. They can occur both in normal and abnormal cranial tissues. Calcium usually deposits in the medial layer of cranial blood vessels [12]. Intracranial calcifications may be physiological or pathological. Physiological calcifications are unaccompanied by any evidence of disease and have no demonstrable pathological cause. They include calcifications of the pineal gland, habenula, choroid plexus, falx, and some idiopathic calcifications in the basal ganglia, vessel walls, sagittal sinus, lens and other non-defined areas [2, 10, 12].

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Simple radiography, computed tomography (CT), magnetic resonance imaging (MRI) and, for infants, sonography all help physicians in the diagnosis of intracranial calcifications, but CT has a high sensitivity in diagnosis because of the hyperdense signals of calcifications in this tomography [4].

Kwak et al. [6, 7] conducted a study on 2877 consecutive cases that had plain CT scanning. In this research calcifications were shown in 67.7% in the pineal region, 57.6% in the choroid plexus of the lateral ventricles and 7.5% in the basal ganglia. They reported that in patients aged from 20 to 79 years the incidence of calcification was significantly higher in males than in females. They also reported calcification of the choroid plexus in 17.4% of cases aged from 15 to 19 years.

In 1978 Abbassioun et al. [1] assessed the presence of intracranial physiological calcification by simple radiography at Shiraz University, Iran. The average incidence of pineal calcification for those over 20 years of age was 18.29% compared to 55% in the United States at the same time.

According to Weins and Stenbeg [12], pineal calcification is found in 25% of individuals over 10 years of age. It is also found in 60–70% of those over 50 years of age. Habenular calcification has been shown in 13% of adults. By simple radiography calcification of the choroid plexus is shown to be 28% and by CT scanning it is shown to be 75% in adults over 40 years of age. Sagittal sinus and falx calcification is found in 7–9% of adults.

In a recent study we wanted to assess the intracranial physiological calcifications of adults by CT scanning. For this purpose we reviewed cranial CT studies of 1569 subjects in Tabriz Imam Khomeini Hospital, Iran from January 1st 2004 to June 30th 2005 as a cross-sectional study.

MATERIAL AND METHODS

CT studies were assessed of 1569 patients aged from 15 to 85 years in Tabriz Imam Khomeini Hospital, Iran from January 1st 2004 to June 30th 2005. The cases were patients with documented trauma who had had cranial CT scanning. The results of CT for the entire sample were negative and there was no demonstrable evidence of pathology. The physiological calcified regions were assessed carefully and a study checklist was filled out for each patient. The frequencies of physiological calcifications in the intracranial structures were assessed. The structures evaluated consisted of (A) the pineal gland, (B) the choroid plexus, (C) the habenula, (D) the basal ganglia, (E) the tentorium cerebelli, sagittal sinus and falx cerebri, (F) vessels and (G) lens and other structures which could be calcified. The falx cerebri and tentorium cerebelli are fibrous membranes, which are located between the two hemispheres of the cerebrum and the sphere of the cerebrum and cerebellum respectively. In addition, the sagittal sinus is located superior to the falx cerebri. We therefore considered all of the calcifications of the tentorium cerebelli, sagittal sinus and falx cerebri in a single group. Calcifications of the lens and other non-defined areas within the skull are also considered to be intracranial calcifications in the literature review [10]. We therefore studied these parts as a group of intracranial calcifications.

A Sytec GE 3000 CT device was used in this study for the CT scanning of subjects. Five-millimetre scans were acquired through the posterior fossa and cranial base and ten-millimetre scans through the middle fossa.

We excluded scans with any pathological evidence. We also excluded scans which had been performed by contrast. We assessed patients' medical histories, noting especially any metabolic disorders, hypertension or chronic disease. Any patient with one of these was excluded from the study, as physiological calcification cannot be discussed without taking into account problems such as calcium-potassium metabolism or parathormone deficiency.

In this cross-sectional study all the subjects were from the north west of Iran. The extracted data were analysed by SPSS software with the use of descriptive statistics and the χ^2 test. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

We divided the sample into seven age groups as follows: 15–24 years (14.2%); 25–34 years (19.8%); 35–44 years (21.8%); 45–54 years (17.1%); 55–64 years (10.4%); 65–74 years (10.5%); 75–85 years (6.1%). Of the 1569 subjects in this study 40.9% were male and 59.1% female. The mean age was 43.9 ± ± 16.1 (min = 15; max = 85), 43.9 ± 15.6 for females (min = 15; max = 85) and 44.0 ± 16.9 for males (min = 15; max = 85). Table 1 presents the frequencies and percentages of the age and sex distribution of the study sample. Table 2 shows the findings of the CT scans in various intracranial sites for different ages and sexes and in total.

Of the 1569 patients 50.0% had both pineal and choroid plexus calcifications (55.5% female and

Table 1. Frequencies and percentages of age and sex distribution of the study sample

Age group	Female		Male		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
15–24	119	53.4	104	46.6	223	14.2
25–34	189	61.0	121	39.0	310	19.8
35–44	210	61.4	132	38.6	342	21.8
45–54	160	59.5	109	40.5	269	17.1
55–64	109	66.9	54	33.1	163	10.4
65–74	92	55.8	73	44.2	165	10.5
75–84	49	50.5	48	49.5	97	6.2
Total	928	59.1	641	40.9	1569	100

44.5% male). Furthermore, 18.7% of subjects had both pineal and habenular calcifications (46.9% female and 53.1% male). Table 3 shows the frequencies and percentages of duplicate calcification in different age and sex groups.

There was a significant relationship between increasing age and an increase in the frequency of pineal gland calcification ($p < 0.05$). There were also significant relationships between increasing age and an increase in the frequency of choroid plexus, vascular, basal ganglia, and tentorium cerebelli, sagittal sinus or falx cerebri calcifications ($p < 0.05$). The relationship between increase in age and increase in frequency of habenular calcification was also significant ($p < 0.05$), but the relationship between the increase in age and increase in frequency of lens and other non-defined calcifications was not statistically significant ($p > 0.05$).

DISCUSSION

According to the results obtained, the most common sites of intracranial physiological calcification areas are the following: 71.0% pineal calcification, 66.2% choroid plexus calcification, 20.1% habenular calcification, 7.3% tentorium cerebelli, sagittal sinus or falx cerebri calcifications, 6.6% vascular calcification, 0.8% basal ganglia calcification and 0.9% lens and other non-defined calcifications. In this study, the tentorium cerebelli, sagittal sinus or falx cerebri calcifications, vascular calcification, choroid plexus calcification, habenular calcification, and pineal calcification were more common in men than in women, but the frequency of basal ganglia calcification was almost equal in the two gender groups. In general, physiological calcifications are more common in men than in women.

In the study of Kwak et al. [6, 7] in Japan the incidence of pineal gland and choroid plexus calcification was lower than in our research, but irrespective of this pineal gland calcification was the most common intracranial physiological calcification in this study too.

If we compare our work with the same study in 1978 in Shiraz, Iran, Abbassioun et al. [1] stated that pineal gland calcification had been found in 18.29% of individuals over 20 years of age, while we found this calcification in 70.8% of our sample. We may conclude that CT is of greater sensitivity in the diagnosis of intracranial physiological calcifications as compared to simple radiography. The varying incidence of calcification in the globe could also be due to the relatively thick CT slice profile (5 mm) relative to the size of the calcifications typically seen in this region.

According to our study, pineal gland calcification is the most common intracranial physiological calcification, and this is in agreement with Weins and Stenbeg [12]. Choroid plexus calcification was in the second place. Pineal calcification was the most common calcification among subjects of 15 to 54 years of age, while for subjects of 55 to 85 years of age the most common calcification was found in the choroid plexus. Habenular calcification was in the third place in all age groups. Basal ganglia calcification is rarely found, but a small increase is seen at older ages such as the 75 to 85 age group. Vascular calcification also increases with age and is most common in 75 to 85 year-old subjects. Tentorium cerebelli, sagittal sinus, and falx cerebri calcifications were most common in old age too, and pineal, habenular, and choroid plexus calcifications also increase at older

Table 2. Intracranial physiological calcifications in various intracranial structures for different age and sex groups and in total

Group	Pineal gland		Choroid plexus		Habenula		Vessels		TSF		Basal ganglia		Lens & others	
	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%
15–24														
Female	71	59.7	52	43.7	12	10.1	2	1.7	6	5.0	0	0.0	0	0.0
Male	67	64.4	44	42.3	17	16.3	0	0.0	7	6.7	0	0.0	0	0.0
Total	138	61.9	96	43.0	29	13.0	2	0.9	13	5.8	0	0.0	0	0.0
25–34														
Female	123	65.1	103	54.5	27	14.3	0	0.0	8	4.2	1	0.5	1	0.5
Male	93	76.9	68	56.2	20	16.5	1	0.8	7	5.8	0	0.0	3	2.5
Total	216	69.7	171	55.2	47	15.2	1	0.3	15	4.8	1	0.3	4	1.3
35–44														
Female	134	63.8	147	70.0	40	19.0	0	0.0	12	5.7	1	0.5	1	0.5
Male	119	90.2	91	68.9	42	31.8	3	2.3	7	5.3	1	0.8	0	0.3
Total	253	74.0	238	69.6	82	24.0	3	0.9	19	5.6	2	0.6	1	0.3
45–54														
Female	114	71.3	109	68.1	27	16.9	6	3.8	16	7.6	0	0.0	3	1.4
Male	86	78.9	82	75.2	29	26.6	3	2.8	6	5.5	0	0.0	0	0.0
Total	200	74.3	191	71.0	56	20.8	9	3.3	22	8.2	0	0.0	3	1.1
55–64														
Female	77	70.6	83	76.1	21	19.3	12	11.0	6	5.5	0	0.0	1	0.9
Male	51	94.4	46	85.2	17	31.5	4	7.4	4	7.4	0	0.0	1	1.9
Total	128	78.5	129	79.1	38	23.3	16	9.8	10	6.1	0	0.0	2	1.2
65–74														
Female	57	62.0	70	76.1	15	16.3	21	22.8	8	8.7	3	3.3	1	1.1
Male	56	76.7	60	82.2	22	30.1	18	24.7	10	13.7	1	1.4	0	0.0
Total	113	68.5	130	78.8	37	22.4	39	23.6	18	10.9	4	2.4	1	0.6
75–85														
Female	42	85.7	40	81.6	10	20.4	17	34.7	5	10.2	2	4.1	3	6.1
Male	39	81.3	43	89.6	19	39.6	18	37.5	13	27.1	2	4.2	0	0.0
Total	81	83.5	83	85.6	29	29.9	35	36.1	18	18.6	4	4.1	3	3.1
Total														
Female	497	77.5	434	67.7	165	25.7	47	7.3	58	9.0	4	0.6	4	0.6
Male	618	66.6	604	65.1	152	16.4	58	6.3	57	6.1	7	0.8	10	1.1
Total	1114	71.0	1038	66.2	315	20.1	104	6.6	115	7.3	12	0.8	14	0.9

FQ — frequency; TSF — tentorium cerebelli, sagittal sinus and falx cerebri

ages. Kendall and Cavangh [5] report the same increase in calcifications in old age.

The incidence of a co-existence of pineal and choroid plexus calcifications was greater in women than in men, but the incidence of a co-existence of pineal and habenular calcifications was greater in men than in women. These duplicate calcifications were most common in subjects of 35 to 44 years of age.

This study has evaluated all the cranial structures and determined percentages for all types of intracranial

Table 3. Frequencies and percentages of duplicate calcification in different age and sex groups

Age group	Pineal gland and choroid plexus calcification						Pineal gland and habenula calcification					
	Female		Male		Total		Female		Male		Total	
	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%
15–24	34	7.8	28	8.0	62	7.9	12	8.7	16	10.3	28	9.5
25–34	76	17.4	58	16.6	134	17.1	24	17.4	20	12.8	44	15.0
35–44	99	22.7	80	22.9	179	22.8	36	26.1	37	23.7	73	24.8
45–54	82	18.8	61	17.5	143	18.2	25	18.1	26	16.7	51	17.3
55–64	62	14.2	40	11.5	102	13.0	18	13.0	16	10.3	34	11.6
65–74	49	11.2	47	13.5	96	12.2	13	9.4	22	14.1	35	11.9
75–85	34	7.8	35	10.0	69	8.8	10	7.2	19	12.2	29	9.9
Total	436	100	349	100	785	100	138	100	156	100	294	100

FQ — frequency

physiological calcification. Although diagnosis of pathological intracranial calcifications is accompanied by a cause of disease, the frequency of physiological intracranial calcifications can be extremely useful in differentiating between pathological and physiological calcification. Although the causes of the intracranial calcifications have not been revealed, factors, such as age, gender, race, geographical region, lifestyle, nutrition, and social behaviour, may affect this process [8, 9, 11]. The results of our study can be used for finding relationships between these calcifications and the above-mentioned factors. Indeed, these statistics can be compared with the incidence of pathological calcifications reported in future studies. Biomedical scientists may also use the results of this study to find the relationship between intracranial physiological calcifications and neurological diseases. For example, relationships have been demonstrated between different types of epilepsy and degenerative diseases of the central nervous system and the incidence of intracranial calcifications [3, 10]. We hope to see more comprehensive and detailed studies of intracranial calcifications in the future.

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