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Original Article

The relationship with age and gender of intracranial physiological calcifications: A study from Corum, Turkey

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Abstract

Aim: The aim of this regional study was to determine the frequency of physiological intracranial calcifications in all age groups in the province of Corum, to determine the relationship with age and gender, and through comparison with literature to present the basic data related to physiological intracranial calcifications.

Materials and Methods: The study included 1011 patients aged 0-93 years that presented at the Emergency Department of Hitit University Medical Faculty Hospital because of head trauma and were applied with Brain Computed Tomography (BCT). A retrospective examination was made of the calcifications on BCT. The calcifications recorded on the CT scans were classified as choroid plexus, pineal gland, habenular commissure, dural, basal ganglia, and others. The patients were examined in 10 age groups of decades starting from zero. In this cross-sectional, retrospective, observational study, the relationship was examined statistically between age and gender of the patients and physiological intercranial calcifications. In addition, the prevalence values of physiological intercranial calcifications in the province of Corum were determined.

Results: There was determined to be a statistically significant increase associated with increasing age in the frequency of pineal gland ($p<0.001$), choroid plexus ($p<0.001$) habenular commissure ($p<0.001$), dural ($p<0.001$), others ($p=0.032$) and basal ganglia calcifications ($p=0.004$). The rates of choroid plexus, pineal gland, and habenular commissure calcifications seen in males were determined to be statistically significantly higher in males than in females ($p=0.044$, $p=0.033$, $p=0.032$, respectively).

Conclusion: This study determined the regional prevalence of physiological intracranial calcifications in the province of Corum and revealed the relationship between these calcifications with age and gender.

Keywords: Age; calcification; gender; intracranial; physiological

INTRODUCTION

Intracranial calcifications form with the accumulation of calcium mineral or metals such as iron in blood vessels, glands or other structures related to the brain. They may be physiological or pathological. The most sensitive method of visualization of intracranial calcifications in current use is brain computed tomography (BCT) (1). Intracranial calcifications defined as physiological or related to advanced age are a common radiographic finding (2).

Physiological intracranial calcifications with no evidence of any accompanying disease and for which no pathological cause can be proven can be defined as all neurodegenerative calcifications associated with age. The areas where intracranial physiological calcifications are most commonly seen are the pineal gland, choroid plexus, habenular commissure, basal ganglia and various sections of the dura mater (3). It has long been believed that physiological intracranial calcifications have no clinical importance. However research is still ongoing because there could be a relationship between various pathological conditions and metabolic abnormalities.

In studies in literature in different geographic regions, there can be seen to be a variation associated with age and gender of the rates of intracranial physiological calcifications determined on CT scanning. The aim of this regional study was to determine the frequency of physiological intracranial calcifications in all age groups in the province of Corum (north-west Turkey), to determine the relationship with age and gender, and through comparison with literature to present the basic data related to physiological intracranial calcifications.

MATERIALS and METHODS

Approval for the study was granted by the Ethics Committee of Hitit University. The study included 1011 patients aged 0-93 years who presented at the Emergency Department of Hitit University Medical Faculty Hospital because of head trauma and were applied with BCT. The

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patients comprised 460 females (mean age 39.5 years) and 551 males (mean age 37.1 years) with a mean age of 38.3 years. A detailed retrospective examination was made of the calcifications on BCT and the findings were recorded. Patients were excluded from the study if they had any pathology, such as hemorrhage or tumor, which could distort the BCT image.

The previous records of the patients were examined and any patients with a diagnosis of a known genetic disease or endocrine-metabolic disease involving parathyroid or calcium metabolism in particular, were excluded from the study. The calcifications recorded on the CT scans were classified as choroid plexus, pineal gland, habenular commissure, dural, basal ganglia, and others. Dural calcifications included calcifications located on typical dural surfaces, primarily the sagittal sinus, falx cerebri, and tentorium cerebelli. Calcifications grouped as others include those seen less often than those in other regions such as arachnoid granulation, diaphragma sellae, petroclinoid or interclinoid ligaments.

Intercranial calcifications were excluded from the study if they were named as benign or physiological for which the lesions were partially explained by pathophysiology or atherosclerosis was in the etiology of vascular calcifications. The patients were examined in 10 age groups of decades starting from zero. The BCT images were acquired as slices of 5mm thickness with a GE Brightspeed 16 Elite device. In this cross-sectional, retrospective, observational study, the relationship was examined between age and gender of the patients and physiological intercranial calcifications. In addition, the prevalence values of physiological intercranial calcifications in the province of Çorum were determined.

Statistical Analysis

Statistical analysis of the data in the study was performed using SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA, License; Hitit University) package program. Descriptive statistics were reported as mean±standard deviation or median (min-max) in accordance with the distribution of the data. Frequency distributions of categorical data were presented as number and percentage (%). Chi-square test or Fisher exact test were used for proportion comparisons between categorical variables. Statistical significance level was accepted as $p < 0.05$.

RESULTS

The distribution of choroid plexus, pineal gland, habenular commissure, dural, basal ganglia and others calcifications seen in males and females in ten different age groups is shown in Table 1. The percentage changes of different classifications associated with increasing age in the ten age groups irrespective of gender are shown in Figure 1. There was determined to be a statistically significant increase associated with increasing age in the frequency of pineal gland ($p<0.001$), choroid plexus ($p<0.001$) habenular commissure ($p<0.001$), dural ($p<0.001$), others ($p=0.032$) and basal ganglia calcifications ($p=0.004$).

Table 1. Comparison of calcification distributions according to the age and gender of the patients

Groups	Number of patients	Choroid plexus		Pineal		Habenular commissure		Dural		Basal ganglia		Others	
		FQ	%	FQ	%	FQ	%	FQ	%	FQ	%	FQ	%
0-10													
Male	31	0	0	1	3.2	1	3.2	0	0	0	0	0	0
Female	38	1	2.6	1	2.6	1	2.6	0	0	0	0	0	0
Total	69	1	1.4	2	2.9	2	2.9	0	0	0	0	0	0
10-20													
Male	102	22	21.6	42	41.2	13	12.7	7	6.9	3	2.9	4	3.9
Female	77	16	20.8	33	42.9	6	7.8	5	6.5	1	1.3	3	3.9
Total	179	38	21.2	75	41.9	19	10.6	12	6.7	4	2.2	7	3.9
20-30													
Male	118	61	51.7	69	58.5	26	22.0	9	7.6	2	1.7	7	5.9
Female	81	48	59.3	49	60.5	15	18.5	10	12.3	3	3.7	6	7.4
Total	199	109	54.8	118	59.3	41	20.6	19	9.5	5	2.5	13	6.5
30-40													
Male	121	80	66.1	85	70.2	37	30.6	11	9.1	3	2.5	11	9.1
Female	82	43	52.4	53	64.6	15	18.3	7	8.5	2	2.4	7	8.5
Total	203	123	60.6	138	68	52	25.6	18	8.9	5	2.5	18	8.9
40-50													
Male	66	50	75.8	47	71.2	17	25.8	7	10.6	1	1.5	5	7.6
Female	47	34	72.3	34	72.3	12	25.5	6	12.8	0	0	3	6.4
Total	113	84	74.3	81	71.7	29	25.7	13	11.5	1	0.9	8	7.1

50-60													
Male	39	40	102.6	33	84.6	17	43.6	9	23.1	1	2.6	0	0
Female	48	29	60.4	29	60.4	14	29.2	12	25	2	4.2	4	8.3
Total	87	69	79.3	62	71.3	31	35.6	21	24.1	3	3.4	4	4.6
60-70													
Male	41	37	90.2	37	90.2	11	26.8	12	29.3	2	4.9	4	9.8
Female	44	33	75	29	65.9	11	25	11	25	3	6.8	5	11.4
Total	85	70	82.4	66	77.6	22	25.9	23	27.1	5	5.9	9	10.6
70-80													
Male	22	20	90.9	19	86.4	9	40.9	8	36.4	2	9.1	3	13.6
Female	25	18	72.0	16	64.0	8	32.0	7	28	3	12	4	16
Total	47	38	80.9	35	74.5	17	36.2	15	31.9	5	10.6	7	14.9
80-90													
Male	9	8	88.7	8	88.9	6	66.7	4	44.4	1	11.1	2	22.2
Female	14	12	85.7	9	64.3	5	35.7	4	28.6	2	14.3	1	7.1
Total	23	20	87	17	73.9	11	47.8	8	34.8	3	13	3	13
90 +													
Male	2	2	100	2	100	2	100	1	50	0	0	0	0
Female	4	4	100	3	75	3	75	1	25	0	0	1	25
Total	6	6	100	5	83.3	5	83.3	2	33.3	0	0	1	16.7

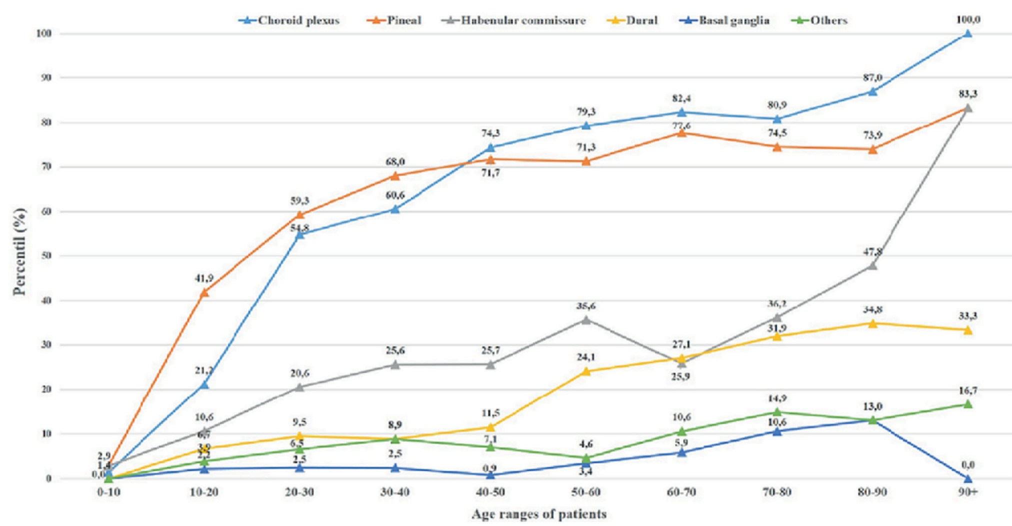

Figure 1. Calcification percentages of patients according to age groups

Comparisons were made of the rates of choroid plexus, pineal gland, habenular commissure, dural, basal ganglia and others calcifications seen in males and females irrespective of the age groups, and the results are shown in Table 2. Similar rates were seen in both males and females for dural, basal ganglia and others calcifications (p=0.523, p=0.488, p=0.593, respectively) (Table 2). The rates of choroid plexus, pineal gland, and habenular commissure calcifications seen in males were determined to be statistically significantly higher in males than in females (p=0.044, p=0.033, p=0.032, respectively) (Table 2).

Table 2. Comparison of calcification distributions according to the gender of the patients

	Gender		
	Male n (%)	Female n (%)	P values
Choroid plexus	320 (58.1)	238 (51.7)	**0.044***
Pineal	343 (57.3)	208 (50.5)	**0.033***
Habenular commissure	139 (25.2)	90 (19.6)	**0.032***
Dural	68 (12.3)	63 (13.7)	0.523
Basal ganglia	15 (2.7)	16 (3.5)	0.488
Others	36 (6.5)	34 (7.4)	0.593

*Chi-square test statistically significant p<0.05

DISCUSSION

According to the results of this cross-sectional study, the region where physiological intercranial calcifications were seen most was the pineal gland (59.25%) followed by the choroid plexus (55.19%), habenular commissure (22.65%), dural (12.96%), others (6.92% and basal ganglia (3.07%).

In similar studies in literature, the pineal gland was reported to be the region where physiological intercranial calcifications are seen most by Yalçin et al (4), Daghighi et al (3), and Kwak et al (5,6). In studies with fewer cases in African countries (7) and Turkey (8), the frequency of pineal gland calcifications has been reported in second place following the choroid plexus. Consistent with previous findings in literature, the results of the current study showed the regions where physiological intracranial calcifications are seen most often to be the pineal gland and the choroid plexus.

The general prevalence of pineal gland calcifications in this cross-sectional study which included all age groups was determined as 59.25%. It is known that together with advancing age, the prevalence of physiological intracranial calcifications increases. As studies in literature have shown differences in distribution of gender and the number of cases according to age groups, it was thought that a comparison of general prevalence would not be meaningful. However, when a multicenter, prospective study by Turgut et al (9) was examined to compare general prevalence, pineal gland calcification general prevalence was seen to be 68.5%. This difference between the incidence rates can be attributed to the lower mean age of the patients in the current study compared to the Turgut et al study (9).

In a study by Yalcin et al (4) which included 12,000 healthy subjects, the prevalence of choroid plexus calcification was found to be 70.2%. In the current study, this rate was 55.19% (Figure 2). The reason for this difference in the rates could be that the mean age of the patients in the current study (38.3 years) was significantly lower than that of the patients in the Yalcin et al study (46.3 years). The difference could also be due to regional differences or ethnic differences of the study populations.

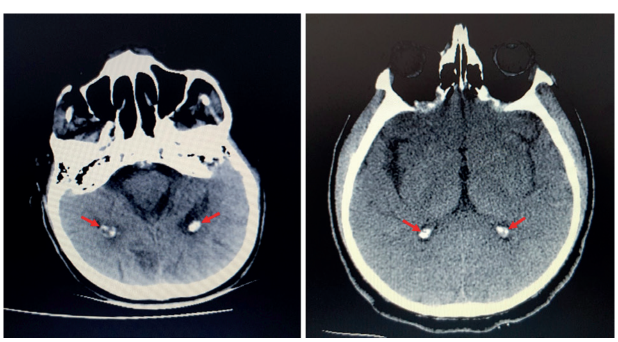

Figure 2. Choroid plexus calcifications (arrow)

Habenular commissure calcification can be defined as a calcification immediately in front of a pineal gland calcification. It is generally seen together with pineal gland calcification (Figure 3) . The prevalence of habenular commissure calcification was reported as 19.2% by Yalcin et al (4), and as 20.1% by Daghighi et al (3). In the current study, the prevalence of habenular commissure calcification was determined as 22.65%, consistent with findings in literature. As a habenular commissure calcification may sometimes be very close to a pineal gland calcification or joined to it, difficulties may be experienced in differentiation. In this respect, as the prevalence of habenular commissure calcification was consistent with literature, this can show that the BCT evaluations of the current study made by a single person were sensitive and accurate.

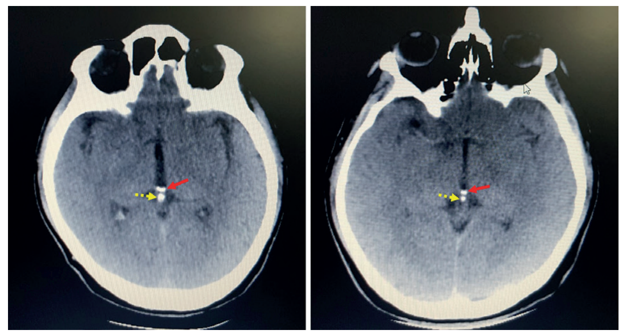

Figure 3. Pineal calcifications (dashed arrow) and Habenular calcifications (arrow)

The dural calcifications in the current study were defined as calcifications located on typical dural surfaces, primarily the sagittal sinus, falx cerebri, and tentorium cerebelli, and prevalence was determined as 12.96% (Figure 4). The general prevalence of tentorium cerebelli, sagittal sinus, and falx cerebri calcifications was determined as 7.3% in a study in Iran by Daghighi et al (3), and dural calcifications were determined at the rate of 12.5% in a study in Turkey by Yalcin et al (4). As the current study prevalence of dural calcifications was similar to that of the previous study in Turkey, and the rate in Iran was much lower, this suggests that there could be regional differences or genetic differences in different populations.

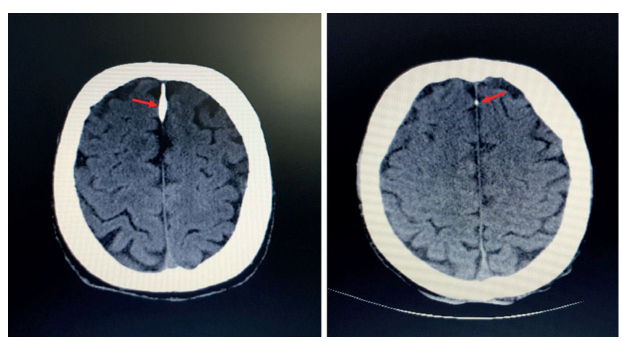

Figure 4. Dural calcifications (arrow)

Basal ganglion calcifications almost always have a tendency to be bilateral, and these have been associated with neuropsychiatric pathologies such as Fahr disease or schizophrenia (Figure 5). None of the current study cases determined with basal ganglion calcification had a diagnosis of Fahr disease or schizophrenia. However, some cases had presented at the neurology or psychiatry polyclinics for various reasons. In the current study, the prevalence of basal ganglion calcification was determined as 3.07%, and in literature this rate has been reported as 1.3% by Yalcin et al (4), 0.8% by Daghighi et al (3), 7.5% by Kwak et al (5,6), and 12.5% by Gomille et al (10). The rate of basal ganglion calcifications in the current study was within the range reported in literature. However, the question of whether basal ganglion calcifications are age-related physiological calcifications or related to various pathologies is the subject of future research.

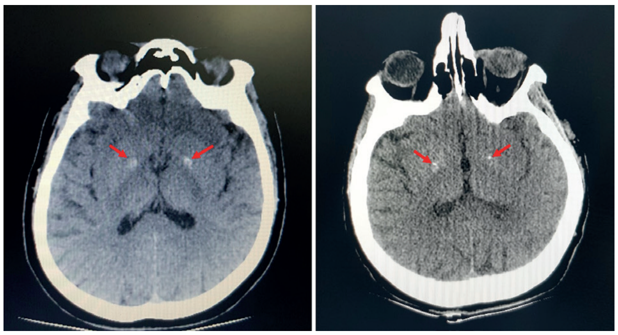

Figure 5. Basal ganglia calcifications (arrow)

According to the results of this study, the frequency of physiological intracranial calcifications seen in the pineal gland, choroid plexus, habenular commissure, dural, basal ganglia and other locations was determined to statistically significantly increase together with advancing age. In literature, an increase together with age was reported for pineal gland calcifications by Turgut et al (9), for pineal gland, choroid plexus, habenular commissure, dural and basal ganglia calcifications by Daghighi et al (3), and for pineal gland, choroid plexus and habenular commissure calcifications by Orcan et al (8), whereas Yalcin et al (4) stated that the prevalence of basal ganglion calcifications did not change with age. Furthermore, in a recently published review by Saade et al (11), the prevalence of physiological intracranial calcifications was reported to increase together with advancing age. In accordance with these findings in literature, the most frequently seen calcifications of pineal gland, choroid plexus, habenular commissure and dural calcifications were determined to be associated with the ageing process, and it can be comfortably said that physiological intercranial calcifications are very rarely seen in patients aged <10 years.

The distribution of the calcifications determined in this study according to gender is shown in Table 2. These results show that pineal gland, choroid plexus, and habenular commissure calcifications were determined at a statistically significantly higher rate in males than females. The frequency of dural, basal ganglia and the other group calcifications showed no significant difference between the genders. When similar studies in literature were examined, Yalcin et al (4) reported that pineal gland, choroid plexus, habenular commissure and dural calcifications were seen statistically significantly more in males than females, whereas basal ganglion calcifications were determined more in females. Daghighi et al (3) reported that pineal gland, choroid plexus, habenular commissure and dural calcifications were seen more in males than females, and no difference was found between the genders in respect of basal ganglion calcifications. It can be said that in general, physiological intracranial calcifications have been reported in literature to be seen more in males than females. From these findings, it can be said that hormonal and genetic differences play a role in the formation of calcifications. To be able to understand why physiological intracranial calcifications are seen more in males, there is a need for further research.

CONCLUSION

There are not many studies in literature that have reported the prevalence of physiological intracranial calcifications. By determining the regional prevalence of physiological intracranial calcifications in the province of Çorum, and examining the relationships with age and gender, this study can be considered to make a contribution to the literature. The practical benefit of this study for clinicians is that by providing familiarity with frequency and regions it will help in the differentiation of physiological intracranial calcifications from pathological calcifications. In the future, if some of these calcifications are associated with various pathological processes, these types of prevalence studies will become even more important.

Competing Interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical Approval: Hitit University medical faculty has been approved by the ethics committee of clinical researches with decision number 2020/166.

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