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# Sleep habits and Physiological Penal Gland Calcification (A Magnified Topographical Evolution Study)

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## Abstract

Physiological pineal gland calcification is a frequent finding in computed tomography brain (CT) and its volume, shape and density is variable. Melatonin is the main product of pineal gland, and its role in sleep is well documented. Two-hundred ten patients were enrolled in this cross-sectional study done at Al-Sadder Medical City-Middle Euphrates Neuroscience Center (MENC)-Najaf; between February 2016 and December 2016. Several PGC parameters include PGC density, PGC volume and PGC cross sectional area were measured. We took their demographic information and their BMI and then questions about their sleep habits was applied to patients. the study group was ($n$=210) was referred for Brain CT for different reasons, mean age (43.9 years), of them male was (118), and female was (92) they represent (56.2% and 43.8%) respectively, that had insomnia was (85, 40.5%), the mean of pineal gland calcification volume (mm3), density (Hu) and cross sectional area ($mm^2$) was (57.5, 131 and 12.5) respectively. In this study there were a strong correlation between PGC density and age, male gender and use of diazepam and Sleep with light on at night & decreased hours of night sleep showed statistically significant correlation with PGC volume and thus on PG function.

***Keyword**: pineal gland, calcification, sleep habit, topographical evaluation.*

## Introduction

The pineal body is shaped like a pinecone, from which the name pineal is derived [1] . It has a role in controlling the/onset of puberty. The pineal body also influence the sleep-wake cycle [1] .The pineal gland ( PG ) measurements about 7.0 x 3.0 x 6.0 mm and is located in between the thalamic bodies [2] . Normal sizes is 14 mm [3].

PG action in humans are still not well understood, its neuroendocrine transducer that forms an integral part of brain. The PG mainly synthesis of melatonin (MEL) is made and secreted in/rhythmic fashion, in the darkest time of the day-night cycle. MEL synthesis and release is supervised by an endogenous/circadian system and is also inhibited by light. Recent studies show a relationship between endogenous MEL levels and the puberty onset. Finally, there was abnormal daily MEL profiles in many of psychiatric disorders and neurological diseases but the important of these was unclear [4].

Melatonin plays roles in various physiological functions including, inducer of spontaneous sleep, protecting cell death so it has anticancer effect[(5-8).]

MRI was the best method for imaging of pineal gland and it is superior to CT and radiograph, although it has poor sensitivity to evaluate calcification [9].

Calcification of PG is a physiological intracranial calcifications that can be said that as all age-related physiologic and neurodegenerative calcifications that are unaccompanied by any evidence of disease and no pathological cause. The calcification increased with increase [10]. With PGC its function will be hampered to an extent, affecting the synthesis of melatonin. If this happens we expect sleep problems. It can also effect on human sexual development and function. Some of PGC is due to increase amount of fluoride in water, other causes of PGC can include: Halides, Calcium supplements and Pesticides[(10-12).] **PGC** lead to sleep related disturbances and daytime tiredness [13].

## Patients and Method

Two-hundred ten patients were enrolled in this cross-sectional study which is conducted at Al-Sadder Medical City-Middle Euphrates Neuroscience Center (MENC)-Najaf; from February 2016 through December 2016. All patients were referred for non contrast brain CT scan study (spiral computed tomography scan Brilliance 64, Philips 2010) for various neurological conditions.

**Inclusion criteria:** any patient aged 10 years or older who already had brain CT scan and agreed to be enrolled in this study, the patient should be fully conscious and oriented to time, place and person.

**Exclusion criteria:** patients aged less than 10 years (as this study concerned with physiological PGC), patients with pineal gland lesions, those who are disoriented to time, place and person, those who had emergency condition, and those with hearing impairment (as this study include list of questions).

Two-hundred ten patients were participated after obtaining their or their family verbal consents and approval from local ethical committee of Medicine a middle Euphrates neuro-center.

The data about patients age ,gender, BMI, Hx of smoking, their occupations and any history of chronic physical illness was obtained.

PGC appears either as oval, round or irregular, we measure its density, volume and cross sectional area (CSA). The PGC density were measured by two methods 1st one manually by taken the density of 1.5mm area in the central of the calcification area and the 2nd method automatically by the machine, the two method show no significant difference statistically so that we depend on the manual method.

To assess the sleep pattern of each patient we applied a list of questions that were used in different sleep researches[14,15] as the following.

1. time of going to bed
2. time of awake
3. hours of sleeping
4. night awake
5. sleep with light on
6. use of media for more than one hour before sleep
7. insomnia
8. wake with alarm
9. drink coffee or tea at night
10. working during day or night
11. Use of sleep medication

These questions were applied to all patients with details about their sleeping adequate hours and their night habits include sleeping with light on during night, uses of media before sleep more than one hour and consumption of tea or coffee.

Data were entered and analyzed using the statistical package for social sciences (SPSS) version 24, 2015, IBM, USA. Descriptive statistics were presented as mean, standard deviation, frequencies and percentages. Student's t test (independent model) was used to compare mean Pineal gland volume, density and cross sectional area across the (Yes vs. No) subgroups. Analysis of variances (ANOVA) test was used to compare the mean across the age, BMI categories and physical activity subgroups.

## Results

Two-hundred ten patients were enrolled in this study. Those patients were referred for brain CT scan noncontract study for various neurological conditions and we correlated the present of PGC with different parameter and the result were as the following:

**Table 1. Demographic characteristics of the studied group (N=210*)***

| Variable | | No. | % |
|---|---|---|---|
| Age (year) | 10-20 | 18 | 8.6 |
| | 21 - 30 | 39 | 18.6 |
| | 31 – 40 | 48 | 22.9 |
| | 41 – 50 | 31 | 14.8 |
| | 51 – 60 | 35 | 16.7 |
| | > 60 | 39 | 18.6 |
| | Mean ± SD | 43.9 ± 17.6 | - |
| | Range | 10 – 86 | - |
| Gender | Male | 118 | 56.2 |
| | Female | 92 | 43.8 |
| Occupational Physical activity | Light | 83 | 39.5 |
| | Moderate | 92 | 43.8 |
| | High | 35 | 16.7 |
| Smoking | Yes | 47 | 22.4 |
| | No | 163 | 77.6 |
| BMI category | Underweight | 8 | 3.8 |
| | Normal | 68 | 32.4 |
| | Overweight | 74 | 35.2 |
| | Obese | 60 | 28.6 |
| | Mean ± SD | 27.9 ± 7.1 | - |
| | Range | 15.6 – 46.2 | - |

In this table show that this study include one hundred eighteen male and ninety two female and only forty seven was smokers and only sixty eight patient within normal BMI. The patients enrolled in this study were (60) patient with hypertension and (25) patient with diabetes mellitus and (12) patient with history of different tumors and (12) with chronic physical pain the other remaining (101) had no medical history of illness.

**Table 2. Distribution of sleep related parameters**

| Variable | | No. | % |
|---|---|---|---|
| Sleep with light on | Yes | 70 | 33.3 |
| | No | 140 | 66.7 |
| Media use before sleep | Yes | 59 | 28.1 |
| | No | 151 | 71.9 |
| Sleep Medication use | Yes | 23 | 11.0 |
| | No | 187 | 89.0 |
| Insomnia | Yes | 85 | 40.5 |
| | No | 125 | 59.5 |
| Awake with alarm | Yes | 43 | 20.5 |
| | No | 167 | 79.5 |
| Tea or coffee intake at night | Yes | 48 | 22.9 |
| | No | 162 | 77.1 |
| Day or night work | Day | 197 | 93.8 |
| | Night | 13 | 6.2 |

This table shows that patients that sleep with light on were seventy and those use sleep medication were twenty three while those with insomnia were eighty five and those who drink tea or coffee were forty eight and only thirteen were work at night.

**Table 3. Mean values of Pineal gland calcification parameters of the patients and Correlation with sleep hour (N=210)**

| Parameter | Mean | SD | Minimum | Maximum | Correlation coefficient (R) | P. value |
|---|---|---|---|---|---|---|
| PGC volume ( mm3 ) | 57.5 | 62.8 | 0.2 | 375.6 | -0.223 | 0.001* |
| PGC density ( HU) | 131.0 | 67.1 | 6.3 | 350.0 | -0.038 | 0.585 |
| Cross sectional area of PGC ( mm2) | 12.5 | 10.3 | 0.2 | 48.6 | -0.060 | 0.389 |
| *Correlation is significant at the 0.05 level | | | | | | |

There was a significant inverse correlation between PGC volume and the hours of sleep (P= 0.001). While there was no significant correlation between time spend in the bed neither with PGC density nor with cross sectional area (P= 0.585 and 0.389) respectively.

**Table 4. Correlation between sleep related variable and PGC volume, density and cross sectional area, of the studied group (N=210)**

| Variable | | Pineal gland volume | | P. value | Pineal gland density | | P. value | Cross sectional area of PGC | | P. value |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean | | | SD | Mean | | SD | Mean | | SD | |
| Sleep with light on | Yes | 74.1 | 9.0 | 0.03* | 132.5 | 7.3 | 0.89 | 12.2 | 1.2 | 0.55 |
| | No | 53.6 | 4.9 | | 131.2 | 5.9 | | 13.1 | 0.9 | |
| Media use | Yes | 57.3 | 6.9 | 0.67 | 128.1 | 8.1 | 0.63 | 13.1 | 1.2 | 0.80 |
| | No | 61.6 | 5.6 | | 133.0 | 5.6 | | 12.7 | 0.9 | |
| Sleep medication use | Yes | 57.4 | 12.7 | 0.82 | 164.1 | 18.4 | 0.013* | 16.1 | 2.7 | 0.098 |
| | No | 60.7 | 4.8 | | 127.6 | 4.6 | | 12.4 | 0.7 | |
| Insomnia | Yes | 62.7 | 6.8 | 0.66 | 129.3 | 7.7 | 0.68 | 11.7 | 1.0 | 0.19 |
| | No | 58.7 | 5.9 | | 133.2 | 5.7 | | 13.6 | 1.0 | |
| Awake with alarm | Yes | 66.5 | 10.5 | 0.48 | 140.6 | 10.0 | 0.32 | 14.2 | 1.8 | 0.35 |
| | No | 58.7 | 4.9 | | 129.3 | 5.2 | | 12.5 | 0.8 | |
| Tea or coffee intake | Yes | 71.4 | 9.7 | 0.17 | 134.6 | 11.0 | 0.72 | 16.2 | 1.8 | 0.012* |
| | No | 56.9 | 5.0 | | 130.7 | 5.0 | | 11.9 | 0.7 | |
| day or night work | Night | 61.6 | 4.7 | 0.27 | 131.0 | 4.8 | 0.61 | 12.8 | 0.7 | 0.73 |
| | Day | 40.9 | 13.5 | | 141.0 | 18.6 | | 13.8 | 2.9 | |

There was a significant correlation between PGC volume and sleep with light on during night (P. value =0.03).While there was no significant correlation with other parameters, (P> 0.05). There was a significant correlation between PGC density and use of sleep medication (diazepam) before night and (P= 0.013), while no correlation found with other parameter. There was a significant correlation between PGC cross sectional area and night intake of tea or coffee, (P = 0.012) while no correlation with other parameter (P= 0.35 and more).

**Table 5. Correlation between demographic characteristics and Pineal gland calcification volume, density and cross sectional area of PGC, of the studied group (N=210)**

| Variable Mean | | Pineal gland calc. volume | | P. value Mean | Pineal gland calc. density | | P. value Mean | Pineal gland calc. Cross sectional area | | P. value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SD | | | SD | | | SD | | |
| Age (year) | ≤ 20 | 73.0 | 16.7 | | 97.4 | 10.9 | | 11.7 | 1.8 | |
| | 21 - 30 | 65.6 | 9.0 | | 120.9 | 9.1 | | 11.5 | 1.5 | |
| | 31 - 40 | 47.8 | 8.7 | | 123.9 | 10.0 | | 12.8 | 1.5 | |
| | 41 - 50 | 57.0 | 9.9 | 0.65 | 137.5 | 9.6 | 0.038* | 13.5 | 1.9 | 0.63 |
| | 51 - 60 | 67.3 | 9.7 | | 153.7 | 12.8 | | 15.4 | 2.2 | |
| | > 60 | 61.0 | 14.3 | | 143.1 | 12.2 | | 11.8 | 1.4 | |
| Gender | Male | 62.0 | 5.9 | 0.68 | 139.9 | 6.5 | 0.041* | 12.9 | 0.9 | 0.85 |
| | Female | 58.3 | 6.9 | | 120.9 | 6.3 | | 12.7 | 1.1 | |
| BMI categories | Underweight | 39.5 | 15.7 | | 124.5 | 30.7 | | 7.5 | 1.6 | |
| | Normal | 63.9 | 7.4 | | 128.5 | 8.3 | | 12.6 | 1.3 | |
| | Overweight | 58.5 | 7.0 | 0.79 | 139.3 | 7.6 | 0.68 | 14.0 | 1.3 | 0.36 |
| | Obese | 61.1 | 9.7 | | 126.7 | 8.4 | | 12.4 | 1.3 | |
| Physical activity | Light | 64.5 | 7.8 | | 137.5 | 8.0 | | 13.5 | 1.1 | |
| | Moderate | 59.0 | 6.3 | 0.69 | 128.1 | 6.4 | 0.60 | 12.2 | 1.0 | 0.70 |
| | Heavy | 53.9 | 9.7 | | 127.3 | 11.2 | | 13.0 | 2.1 | |
| Smoking | Yes | 66.9 | 8.7 | | 141.8 | 10.8 | | 12.7 | 1.6 | |
| | No | 58.5 | 5.2 | 0.43 | 128.7 | 5.1 | 0.23 | 12.8 | 0.8 | 0.95 |

This table shows that there is no significant correlation between PGC volume and cross sectional area with different selected demographic characteristics (*P* = 0.43 and *P*>0.3) respectively. There was a significant correlation between PGC density and the age as well as male gender (*P*= 0.038 and *P*= 0.041) respectively.

## Discussion

Since its first description autopsy specimens skull radiographs by Schüller in 1918 [15], the exact mechanisms behind the development of calcification in pineal gland are difficult to found, although there is an evidence (experimental), that calcification may be an indicator of the past secretary activity of the gland and/or of degeneration. The increased incidence of calcification in pineal gland with person's age it may suggests cerebral degenerative changes [17].

This current study shows correlation between PGC (density, volume and CSA) primarily with patient's sleep pattern and secondarily with several other selected parameters. in regard to sleeping pattern this study found that there was a significant correlation between PGC density and sleep with light on ($P$=0.013), this finding was comparable with a study done by Bogdan Lewczuk (2014) [18] They discuss relationship between light exposure and MEL with breast cancer risk, they found there was a significant correlation between use of light on and production of MEL which result in increased PGC density. Another study was done by Nathan PJ [19] showed that plasma MEL concentration which is inhibited by light have indicated this may be related with PGC; although no direct study correlate the PGC and sleep with light on during night as they depend indirectly on the level of MEL.

## Conclusion

Age showed statistically significant correlation with increase PGC density and in turn on PG function, male gender showed statistically significant correlation with increase PGC density and in turn on PG function. Use of diazepam showed statistically significant correlation with increase PGC density and in turn on PG function, sleep with light on at night and decreased hours of night sleep showed statistically significant correlation with increase PGC volume, and tea or coffee consumption at night showed statistically significant correlation with increase cross-section area of PGC. And physical activity, BMI, smoking and past medical history showed no significant correlation with other PGC parameters.

**Financial Disclosure:** There is no financial disclosure.

**Conflict of Interest:** None to declare.

**Ethical Clearance:** All experimental protocols were approved under the Department of Radiology, AL-Sadder Medical City and all experiments were carried out in accordance with approved guidelines.

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