CHOROID PLEXUS - PINEAL GLAND CORRELATIONS. MEDICAL ANTHROPOLOGY-COMPUTED TOMOGRAPHY STUDIES. INTRACRANIAL PHYSIOLOGICAL CALCIFICATION

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OBJECTIVES*:* This study was carried out on 1290 patients, whose choroids plexus and pineal gland were examined on computed tomography. Aim: To check the correspondence between the choroid plexuses and the pineal gland calcifications along age groups and sex; and the connections between these calcifications and associated pathology.

MATERIALS AND METHODS*:* The study group consisted of patients of both sexes, within six age intervals.

RESULTS: In order to classify the calcification variants, eight types of combinations were ordered and can be seen in CT: two refer to extreme variants: totally uncalcified (type 1) and totally calcified (type 8); bilateral, symmetrical variants (types 4 and 5); the other four types include the asymmetrical calcifications (2, 3, 6 and 7). After the anthropological study the results demonstrate that there are significant differences between calcification of the choroids plexus and those of the pineal gland with the two sexes, on age groups and pathological ground. For type 1-totally uncalcified the maximum frequency is around 70% with ages under 19. For type 8 - totally calcified, bilateral, the maximum frequency is around 50% with age groups 48-59 and 60-71. For type 4 - calcification only of choroid plexus, one finds a continuous increase from about 10% at the first age group to about 25% at the last group, while for type 5- calcification only of the pineal gland the frequency is 10%–20%. We started from the hypothesis that the presence of these calcifications is physiological, and has an active adaptative metabolic part depending on many factors, among which the individual constitutional ground is also present.

CONCLUSIONS: The age is not the main cause of the calcification types, but a process of adaptative-reactive variability of interface type, playing an integrating mediating part.

Key words*:* physiological calcification, choroid plexus, pineal gland, anthropological typology.

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INTRODUCTION

Objectives. To prove the existence of new variants of intracranial physiological calcification (ICP): of the glomus of the choroids plexus (CP) at the level of the temporal or occipital horns of the lateral ventricles, correlated with that of the pineal gland (PG), which were presented in a previous report (1). These calcifications, not diagnosed as pathological, are pointed out on computed tomography image (CTI) and frequently appear in the same cranial axial section even though PG and CP have no known direct topographical or anatomic-functional connections and their morphology does not justify the situation of the calcifications in the same plane. Our hypothesis refers to the existence of a complex interdependence of "interface type" (2), among the ICP phenomena in the studied area, interdependences with the metabolically phenomena involved in the hydro-mineral and bio-electromagnetical homeostasis of the entire human body. As a result, we also considered the hypothesis of the existence of a complex interface which "processes" the information that assures the coexistence and the dependence among all phenomena of physiological calcification in the body, including the intra-cranial ones.

In the activity of the complex formed of CP and PG we can notice the presence of a physiological anthropological typology (biophysical-chemical)**,** neuroendocrine (3).

The motivation of our interdisciplinary, anthropo-medical approach is to understand the principles, the causes, the consequences, as well as the common plan [4) that forms the basis of these *phenomena of physiological calcification.* This especially relates to the type of structures belonging to different systems: CP - a basic component of the blood-brain barrier (BBB), the main access of hydrophilic substances from the blood to the brain (4,5) and PG - a neuroendocrine gland with the role of phototransductor - mediator and involved in the fundamental biorhythm light**/**darkness (6). We also intend to answer questions such as: which are the means of communication through which these structures are coordinated? Why, when and who determines the calcification at the BBB level?

The general process of calcification of the human body is extensively studied nowadays. Calcification can be physiological or pathological (7). The only formations in the body which normally undertake calcification phenomena are the bones and the teeth. (Their hardness is given by *the deposits of calcium salts* inside them). Calcification is considered a physiological process which intensifies during the ontogenesis, up to a certain stage of life. After that, an inverse process takes place - osteoporosis-, sometimes accompanied by other pathological phenomena (6). Calcium is the most abundant mineral in the human body and it circulates in the blood, assuring the regulation of important activities. Other organs' calcifications result from the calcium involvement in different functions. The phenomenon of calcification in glands and other organs is associated, in most studies, with dysfunctions (8).

From an anthropological perspective**,** the interest for CP is determined by the importance of their role and involvement in the anthropogenesis. We take into consideration the particularities of the evolution of the cerebral ventricular system which can be followed in the human embryogenesis - morpho-functional evolution of the human brain. During these changes, the cavities of the vesicles in the neural tubes become the encephalic ventricular system, with cerebrospinal fluid (CSF) and having as an exchange interface the CP. The calcification phenomenon in the human ontogeny leads to physiological differentiations**.**

Interdisciplinary systematic research can lead to *some criteria, principles or even general laws of manifestation* of the leap phenomena. Crossing *the physiological barrier can be seen as a natural, real interface, with similar characteristics as in the computers technology* (they receive, codify, memorise, process, retransmit specific information)*.* The calcification we signalled appears as a marker for homeostasis.

The literature dedicated to CP is very rich, especially in human pathology issues (9,10). The approaches from the physiological point of view include only tangent information, not under the evolutive comparative aspect (philo or ontogeny), that is anthropological. The plexus, as a particular structure in the human body, is formed of blood vessels, non-systematically woven. We remind the fact that at the GP lobes periphery, the pinealocytes extensions form a marginal plexus and set up tight contacts with the highly vascularised capillary network.

Choroid plexus (CP). CP is a vasculo-epithelial structure, located in the cerebral ventricular system (lateral ventricles, ventricle III and ventricle IV), resulted from the coalescence of the pia mater with the ependyma. It appears as thin, red balls, due to the rich vascularisation in the ventricles. The capillaries are large or tight, and have fenestrations. The calcified concretions observed at the level of lateral ventricles are part of the so-called “brain sand” or corpora arenacea. A part of the CP is near the PG, whose secretion can also become calcified. The calcareous formations analysed electronomicroscopically are not amorphous deposits, but crystallised special forms, lamellary–concentrical (calcospherules) which, through aggregation, produce calcareous concretions (11). CP produce cerebrospinal fluid (CSF) which is inside the cerebral ventricles and in the subarachnoidian space around the spinal belt. CSF is filtered at the capillaries’ level, where we find simple, cuboidal epithelial cells. On their free surface we distinguish several fringes and villous processes which amplify up to 200 cm^2 the area of exchange, that is four times larger than the area of the entire ventricular system. It is formed of ionic secretions which are actively transported from the CP capillaries level in CSF and the blood, due to the concentration gradients and passively, through diffusion, due to electrochemical gradients, like Na^+. The CP morphofunctional unity is the choroidian villus, formed of a conjunctive-vascular axis, produced by the evagination of pia mater and covered by a cellular layer from the ependyma. Under the choroid epithelial cells and the basal lamina, there is the connection tissue. It is formed of collagenous fibres which surround the complex formed of small arteries,

arterioles and large venous sinuses. Circulation is extremely intense and the pressure generated by the pulsations of the choroidal arteries also assures CSF circulation. Even if the brain represents around 2.5% of the body weight, 15% of the cardiac minute-volume is directed at this level. It is an adaptative answer of intensification of the blood perfusion at the requests of the very high metabolic rate through an increase of the vascular network. This fact explains the interface quality which assures the main role of CP in the CSF secretion and in the removal of some noxious substances in the liquid spaces. Recent research indicates pathogenic correlations between degenerative changes of the cerebral cortex and those of the CP as well as degenerative fibrillary changes in these, as manifestations of the Alzheimer disease. CP tumors are rare, under 1% of the brain tumours (10).

Taking into consideration the above-mentioned facts, we aimed to see which are the factors that determine the CP physiological calcification and what is its role in a specialized structure of interface type, in the human brain, which mediates and controls the *"third circulation"* of the body - the CSF (4, 5).

MATERIALS AND METHODS

The materials analyzed consisted of computed tomography images (CTI) of the cranium, on which we noticed the presence of opaque hyperdense formations (HD), of millimeters and with different forms, that we considered as CP calcifications. These are symmetrically situated at the left and/or right side from the cranium symmetry center, marked by the presence of PG.

The analyzed sample is the same with that for the **PG** calcification, this is why we will not present its detailed structure, which was given in a previous paper (1), but we kept, in Table 1, only its global values, which will be useful for us in the analysis of the below mentioned data.

Table 1. Global structure of the available samples, on age and sex categories

Number of patients	**Total**		**Age groups [1]**				
	Sex	No. %	< 20	21-40	41-60	61-80	>80
No.	F	581	88	129	175	160	29
%		45	15.1 [1]	22.2	30.1	27.5	5
No.	M	709	143	163	193	188	22
%		55	20.2	23	27.2	26.5	3.1
Total	F+M	1290	231	292	368	348	51

[1])on each line, the addition of the percentages in the 5 cells corresponding to the age groups is 100%.

Patients. The study group includes 1290 patients with ages between 1 and 91, both sexes. To the age categories 1, 2 and 3 we took into consideration in the first part of the paper (out of 10, 20 or 30 years), each of them having specific anthropological relevance, we included here the age groups calculated on the basis of statistical criteria which have, in this analytical phase of our research, a greater demonstrative relevance. We can notice a particularity of the sample: the male percentage is 10% bigger than the female one and the distribution on ages is balanced excepting the last group, while at the females the ages are slightly increasing.

We remind here the fact that the patients come from three emergency services and a specialized service of endocrinology, and they were diagnosed on the CT basis. According to the hospitalization diagnosis, we grouped them in six categories: cranial-cerebral trauma (CCT), neurological diseases (N), endocrine diseases (E), intra-cranial expansive processes (ICEP), stroke (S) and other different diagnoses (OTHERS). We also mention the fact that, in this research, in the context of an anthropological approach, the variants of the sickness or health state were considered as being part of the *human* variability, which, in general anthropological acceptance, involves types of anthropological constitutional ground (with sanogen or pathogen idiosyncrasies)**.** In the examination of the results, *the CCT category was considered as a possible reference group* for the health states (apparent, relative), therefore a mirror of the sample compared to the types of pathological ground represented by the other categories of diseases taken into consideration.

We used the following research methods and methodologies: computed tomography investigation was made with a General Electric CT-Pace-Technic system, Examination protocol: patient's position - dorsal decubitus; section plane: orbito-meatal; moving direction: negative-caudo-cranial; axial cranial screening-contiguous exam: 5mm section/interval - 5mm for the posterior fossa; section thickness - 10mm/interval - 10mm supratentorial; running time: 2-3 seconds; kilovoltage: 120kV; milliamperage: 130mA, i.v. contrast; non-ionical monomerical substances: Ultravist (Schering AG), Iopamiro (Bracco), Omnipaque (Amersham).

CT images analysis. The phenomenon of physiological calcification (specifically structured deposits) in GP and in CP presents the following theoretical variants - Table 2 and Fig. 1a & 1b - and is pointed out through computed tomography images (CTI) - (Fig. 2).

Table 2. Types of calcification of the choroid plexus correlated with the calcification of the pineal

Type of structure: Non-calcified (nn)/calcified (yy)	**Pineal gland**							
	Non-calcified (n-)				**Calcified (y-)**			
Choroid plexus left right	n-nn 1	n-yn 2	n-ny 3	n-yy 4	y-nn 5	y-yn 6	y-ny 7	y-yy 8

[1] n-yn (type 2) means non-calcified pineal gland, calcified left choroid plexus, the right one non-calcified

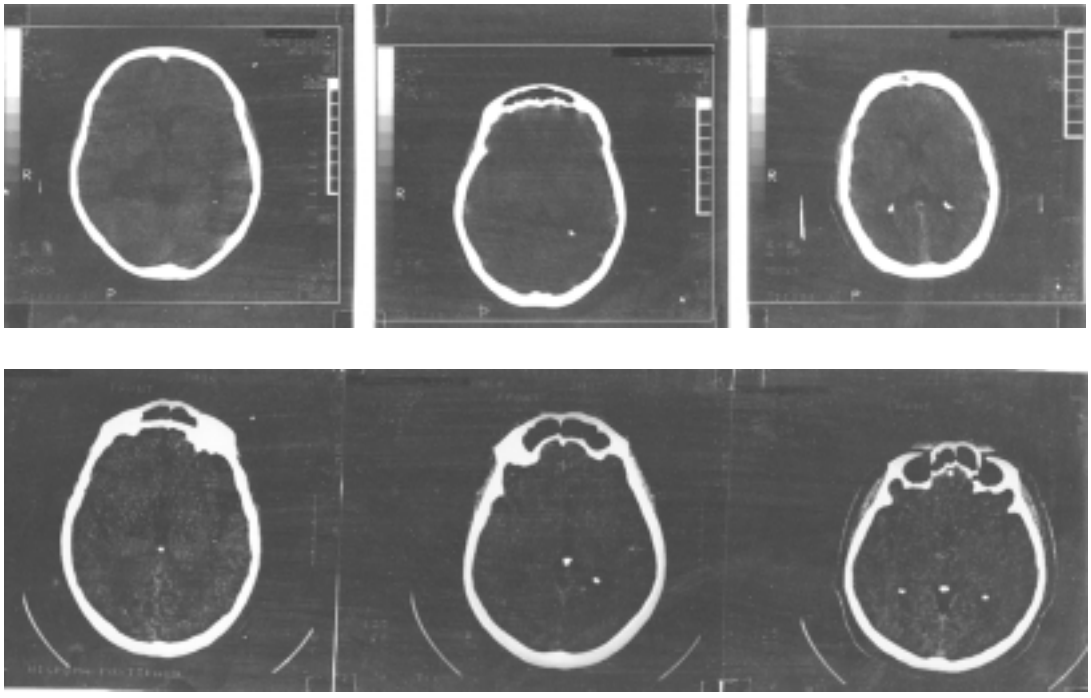

Figure 1. Computed tomography images illustrate the calcification types.
1a. n-nn (1), n-ny (3), n-yy (4) of the choroid plexus, correlated with pineal gland calcification.
In order to follow analysis more easily we specify the folowing aspects: out of the 8 types 1,…8 two refer to extreme variants: totally noncalcified–type 1 and totally calcified–type 8; other two refer to symmetrical (bilateral) variants–4 and 5; the other four comprise asymmetrical calcification variants –2,3,6 and 7. These variants can be further followed when discussing and interpreting the results of this study.
1b. y-nn (5), y-ny (7), y-yy (8) of choroid plexus, correlated with pineal gland calcification.

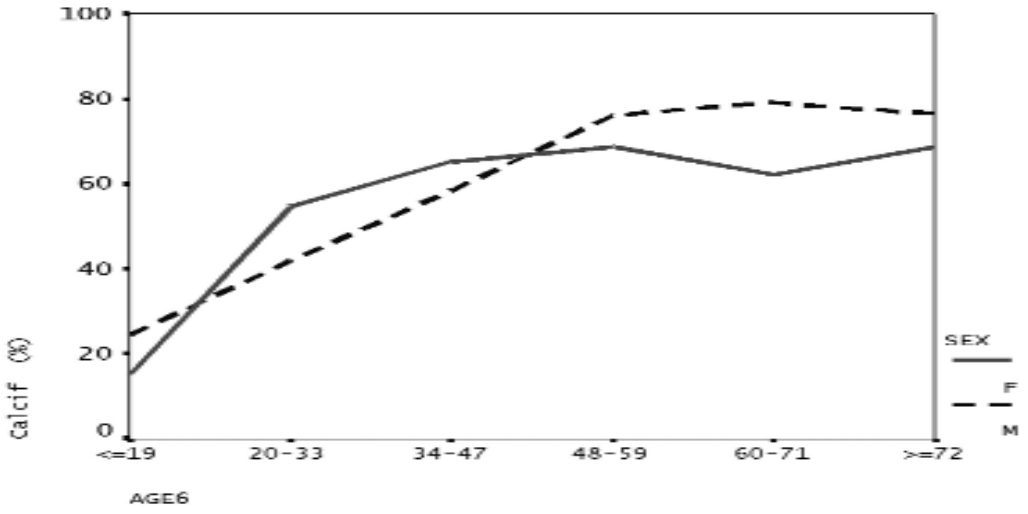

Figure 2. Frequency of bilateral calcifications of the choroid plexus, related to sex and age groups.

Anthropological interdisciplinary analysis. Our approach started from the idea that there are global functional units among the phenomena and processes in the human body, especially regarding calcification, *mediated by specific interfaces***.**

In the methodology we used in organizing the study in which the calcification phenomenon is at the same time cause and effect of a long process, the physiological process of evolution and adaptation, we did not exclude any interdependence among the multitude of possible factors. Subsequent to a preliminary analysis, about which we gave some explanations in the first part of our paper, we keep the fact that:

-reference to *age categories* which include the following stages: childhood, puberty, youth, adulthood or senescence, etc., reflect *different levels of metabolic involvement* of the phenomenon of physiological calcification.

-reference to the *two sexes***,** independent or correlated to the age categories, can lead to *contradictory results* due to the sexual difference which appears in the profile of the neuro-endocrine phenomena during life;

-reference to the number of patients on ailment groups is purely orientative, due to the amplification of the pathology as age grows and to the difficulties in establishing a real diagnosis of the constitutional anthropological ground (12).

We suggest that a *longitudinal study on a significant GROUP of healthy or sick individuals* could bring supplementary information, in dynamics, for the fundamentation of an anthropological, medical point of view, on the correlation between the phenomenon of calcification, the state of health and the medical diagnosis.

Statistical analysis of the interdependences between the CP calcification, sex, age and diagnosis was made by the use of the "logit" variant of the log-linear model, thoroughly described in a previous paper (1,13).

The statistical analysis of the interdependence between computed tomography image hyperdensity process (CTIHDP), sex, age and diagnosis was made using the "logit" variant of the log-linear model (22):

Log-linear model analyses the interdependence between pineal gland calcification, sex, age and diagnosis.

Description of the variables (factors) included in the model:

ITP: it describes the tomographic image of the pineal gland as follows: ITP=1 for the **CTIHDP** case, ITP=0 in the opposite case;

SEX: M for male; F for female;

AGE: Six age intervals have been defined so that each contains the same number of cases (16.67% of the whole GROUP), as follows: AGE=1 if the patient age is at most 19; AGE=2 if the age ranges between 20 and 33 years old; AGE=3 if the age ranges between 34 and 47 years old; AGE=4 if the age ranges between 48 and 59 years old; AGE=5 if the age ranges between 60 and 71 years old; AGE=6 if the age is at least 72 years old.

DIAGNOSIS: The classes of diagnosis are the following: CCT= cranio-cere-

bral trauma; N= neurologic disorders; E= endocrine disorders; S= stroke; ICEP= intra-cranial expanding process; OTHERS= other disorders.

Groups: identifies the 4 groups. Variable GROUP identifies the four medical units in which the sample was collected. Variable GROUP will have to be included in the model in order to take into account the inherent differences existing in the four medical units (different structure of patients, different diagnoses, different protocol of tomographic investigations).

Taking into account the fact that interdependences of more than 2 variables are to be analysed, the use of a model of multidimensional statistical analysis is required. It is worth remembering that, within a multidimensional context, testing the interdependence between two variables (say **ITP** and AGE) is not reduced to the bidimensional case (i.e. variables SEX and DIAGN cannot be ignored).

For instance, in our case, three bidimensional analyses (which exclusively consider pairs of variables and apply test c^2 in the bidimensional contingency tables) lead to the following conclusions: a) ITP and AGE are dependent variables; b) DIAGN and AGE are also dependent; c) ITP and DIAGN, are, in their turn, dependent. Yet a question arises: is dependence c) authentic or does variable AGE function as a "confusion factor" as age influences ("to a certain extent controls") both **CTIHDP** and the diagnosis. It is possible, therefore, that dependence between ITP and DIAGN be exclusively the effect of the "influences" Age has upon both variables. In this case, for a fixed value of the age, variables ITP and DIAGN may be independent, even though in the bidimensional analysis they appear to be dependent!

The conclusion is that, roughly speaking, bidimensional methods cannot offer relevant results for the multidimensional case. Consequently, we resorted to a log-linear model in the "logit" variant (22).

The log-linear model classifies all the individuals (patients, in our case) in definite cells according to the values of the discrete variables under consideration. The dependent variable of the model is the number of cases (frequency) in each cell, and the explicative variables are the model variables (in case of log-linear analysis, they are called "factors").

Presentation of logit models. In order to study the calcification incidences depending on age, sex and diagnosis we will use *OR, **CTIHDP** rate*, defined as follows: *the ratio between the probability of **CTIHDP** presence and the probability of **CTIHDP** absence*. OR (odd ratio) indicators are widely used in epidemiology in order to determine a relative risk in the analysis of the risk factors. Here OR will not be interpreted within the context of the risk factor study. In our case we will *compare **CTIHDP** incidences for various values of the factors under consideration (age, sex, diagnosis, GROUP).*

*The definition and calculation relations for OR, as an indicator of **CTIHDP** incidence in the most general variant considered, are the following:*

$ln(OR_{sadl}) = ln(p_{1/sadl}/p_{0/sadl}) = \delta s^{Sex} + \delta a^{Age} + \delta d^{Dgn} + \delta g^{group}$ (1), *where:*

s is the variable value SEX (s=M,F);

a is the variable value AGE (a=1,2,3,4,5,6);

d is the variable value DIAGN (d=CCT, N, E,S, ICEP, OTHERS);

g is the variable value group (I=1,2,3,4).

p1/sadl (p0/sadl respectively) is ***CTIHDP*** probability (***CTIHDP*** absence respectively) depending on the following values : SEX=s, AGE=a, DIAGN=d and GROUP=g;

δs^{Sex}, δa^{Age}, δd^{Dgn}, δg^{group} define the 2nd order interactions of **ITP** factor with one of the factors SEX, AGE, DIAGN, GROUP, respectively.

We should specify the fact that the model under consideration, in its most general form, may contain 3rd order or higher interactions between **ITP** and SEX, AGE, DIAGN, GROUP. Relation (1) does not contain such interactions because, in our case, all these interactions are not significant from the statistical point of view (**ITP** factor does not have significant interactions higher than 2nd order).

At least theoretically, relation (1) allows calculation of OR rate for each combination of factor values. In our case we did not use the general form of relation (1). We used two variants with three factors each: SEX, AGE, GROUP and respectively SEX, AGE, DIAGN.

If we do not consider factor GROUP, but we consider factors SEX, AGE, DIAGN, one may determine $2\times6\times6=72$ values of OR rate, one for each possible combination of the values the factors may get. In order to avoid complications, we will resort to a simpler interpretation of relation (1) as follows: *OR is a rising function versus 'delta'.*

Each patient is described in the database through the following seven variables: age, sex, group (medical unity wherefrom the patient came), diagnosis, characterization of the computed tomography image of the pineal (calcified or not), characterization of the CT image of left respectively right choroid plexus (calcified or not). On the other hand, ignoring some variables in a multidimensional analysis can lead to erroneous conclusions. Exposing the results through the "logit" variant of the log-linear model used by us tried to eliminate these difficulties. We will signal if the conclusions hereby presented will be or not statistically tested.

Description of the analysed variables. We briefly present the following, regarding the values and qualities of the factors. The six age intervals subsequently considered (1-19), (20-33), (34-47), (48-59), (60-71), and over 71, were such defined so that each of them contains the same number of cases (16.67% of the total in our database). This structure of our database facilitates the testing of such statistical hypotheses and guarantees the relevance of the presented tables and graphical representations. The reader interested in an anthropological approach can obtain the intervals (1-33), (34-59), over 59 by grouping two adjacent intervals. These intervals are equivalent to those offered by the "young - adult - elderly " classification (usually defined in the intervals (0-30), (31-60), over 60.

CTIHDP 4 : describes the CT image of four types (aspects) of calcification of the choroid plexus as such: yy = calcification both in the left plexus (Lft) and in the right plexus (Rig); yn = calcification in the left plexus and non-calcification in the

right plexus; **ny** = non-calcification in the left plexus and calcification in the right plexus, **nn** = non-calcification both in the left and in the right plexus;

CTIHDP 2: describes the tomographical image of the choroid plexus **exclusively for the symmetrical case,** as such: yy = calcification both in the left plexus and in the right plexus; nn = non-calcification both in the left plexus and in the right plexus – **bilateral**, variable referring to **89%** of the cases in the database, **11%** being the cases which present **unilateral** calcification and which were not taken into account in the study, as they need a separate analysis (Table 1);

CTIHDP describes the tomographic image of the pineal gland as such: n = non-calcification, y = calcification.

RESULTS

We find it useful to briefly point out the main results and conclusions related to the PG physiological calcification in the first paper [1], leaving some particular aspects to be inserted in this study, in the comparative analysis with the CP calcification, therefore we stress the following:

– The rate of frequency in GP calcifications significantly increases with age in the interval (1- 47 years), *the subsequent values do not differ significantly from the statistical point of view* and they are bigger in M than in F.

– Independently of the diagnosis, for ages under 19 the frequency of GP calcification is smaller than the frequency of non-calcification absence.

– Maximum frequencies of calcification which appear in "middle ages" suggest the suitable result according to which *PG calcification is physiological* (correlated with the bone system calcification) but also the result according to which *its calcification is a marker of some ailments that sort at "the third age"*.

– We stress that the frequency of the calcification phenomenon has a **maximum of the growth rate** of up to around 40 years and a ***slight tendency of decrease with the age -*** at the TCC group, the average for all groups is around **50%.**

These facts gave us reasons to consider our hypothesis as confirmed and to continue to support the theory that this phenomenon marks *the presence of some metabolic physiological differentiation, very probably involved in the calcium homeostasis, for at least two variants of complementary activities: calcification / non-calcification of human bodies.*

The similar study made on the CP calcifications and on their correlations with the PG calcification, seen as *phenomena physiologically "associated" in an interface**,*** brings supplementary information and results in different metabolic variants of intracranial calcification. We will expose these results here below. We stress the fact that the observations that follow regarding graphs and tables find their theoretical justification in the statistical analysis undertaken.

1. Study of the choroid plexus calcification

Frequency of the calcification types of choroids plexus in the four groups, independent of sex, age and diagnosis is presented in Table 3.

Table 3. Frequency of the calcification types in the choroid plexus in the four groups, independent of sex, age and diagnosis

Calcified choroid plexus	**No. of patients %**	**Groups**				**Total**
left right		L1	L2	L3	L4	No. %
nn	No	184 [2]	104	39	164	491
	%	41.3	35.5	22.2	43.6	38.1
ny [1]	No	30	33	13	2	78
	%	6.7	11.3	7.4	0.5	6
yn	No	29	24	12		65
	%	6.5	8.2	6.8		5
yy	No	202	132	112	210	656
	%	45.4	45.1	63.6	55.9	50.9
Total	No	445	293	176	376	1290

ny [1]=non-calcified left choroid plexus, the right one calcified;
[2] example=in group L1, 184 patients have PC=nn, both choroid plexuses are non-calcified.

Distribution of the calcification types of CP significantly differ in the four groups. Frequency of the bilateral non-calcifications - nn is around 38%, and that of bilateral calcification - yy is 51%. Frequency of calcifications - yy is much bigger in the groups L3 and L4 with dominant endocrine pathology (E), respectively neurological (N).

In each of the four groups, the frequencies of unilateral calcifications (asymmetrical left calcification yn and respectively ny, right) have values under 10%, excepting the GROUP L2, with the dominant of the CCT diagnosis, where the value gets over 11%. Therefore, we can interpret that, by a bilateral or unilateral disposition, there is a way to the adaptive variability of calcification methods, with different growth rates (1).

Further on, we will not insist in our analysis on the asymmetries, taking into consideration the fact that, due to the little number of unilateral calcifications (143 cases), the possibilities to make some consistent statistical analyses for the asymmetrical case are limited.

2. The log-linear analysis for the symmetrical case - both CP calcified yy, both CP non-calcified nn

In order to study, in the symmetrical case, the factors which influence the CP calcification, we resorted to a general log-linear model (13). The analysis was made taking into consideration 89% of the database, as previously mentioned, exclusively corresponding to the **symmetrical** cases yy and nn**.** We will not return to the

theoretical details regarding the considered model. We will keep ourselves to the conclusions.

The simultaneous analysis of the dependences among groups, age, sex and CP calcification in the yy–nn case permitted the identification of the following significant interactions: **1**. age, sex, GROUP; **2**. CP bilateral calcification, sex; **3.** CP bilateral calcification, age; **4.** CP bilateral calcification, GROUP. The interpretation of the **dependencies (D**) is the following:

D - 1. The structure related to the sex and the age of the four groups is different (independent of the CP calcification). Moreover, sex and age are dependent: age for F is significantly bigger than for M.

D - 2. CP calcification and sex are conditionally dependent; the conditioning is made in relation with the patients' GROUP and age (Fig. 2).

D - 3. Independent of GROUP and sex, the frequency of CP calcifications is dependent on age.

D - 4. Independent of the sex and age of the patients, ***the frequency of bilateral calcifications significantly differs among groups.*** This can be explained by the different specificity of each of the four medical institutions, which offered the groups (the diagnoses were distributed differently).

Frequency of CP **bilateral** calcifications increases with the age up to 60. After this age the incidence of CP calcifications is relatively constant. In our case, the percentage of CP calcifications for patients over 60 is around 80% for men and 60% for women. This difference is statistically significant for the 60-71 group.

3. Frequency of calcification of the choroid plexus correlated to the calcification of the pineal gland

The frequency of the pineal gland calcification reported to age groups (comparative presentation with the calcification types [1)] of the choroid plexus) [2] is presented in Fig. 3.

We notice the association between PG and CP calcification for the same individual. The frequency of PG calcification is minimal for the absence of CP calcification - nn (under 20%) and maximal for the bilateral calcification - yy (around 70%).

For those with calcified PG, the frequency of CP calcification on age categories, presented comparatively, shows that this is lower for the non-calcification (lower line), followed by those with unilateral calcification (dotted line) and it is between 50% and 75% for the bilateral calcification (upper line).

Analysis of the association types of pineal calcification - choroid plexus (Pin_Plex) is shown in Figs. 4 and 5.

[1)] The patients with unilateral CP calcification were excluded from the analysis (in our case, their percentage is 11%).

[2)] The four types of calcification are defined as follows: y_yy = PG calcification and CP **bilateral** calcification; y_nn = PG calcification and absence of

CP calcification; n_yy = absence of PG calcification and bilateral calcification of CP; n_nn = absence of calcification both for PG and CP.

If we follow the succession of the columns corresponding to the four types of calcification, with the age axis, we notice that:

-the general process of calcification of the ensemble of intra-cranial structures CP - PG increases up to 60 years of age,

-the frequency of the type of bilateral calcification (symmetrical) - y_yy also increases, up to 60 years of age.

-the frequency of the n_yy category does not suggest a certain tendency of arranged variation.

The frequency of the totally non-calcified category n_nn decreases to 70 years of age and has a small increase for the category over 72 years of age.

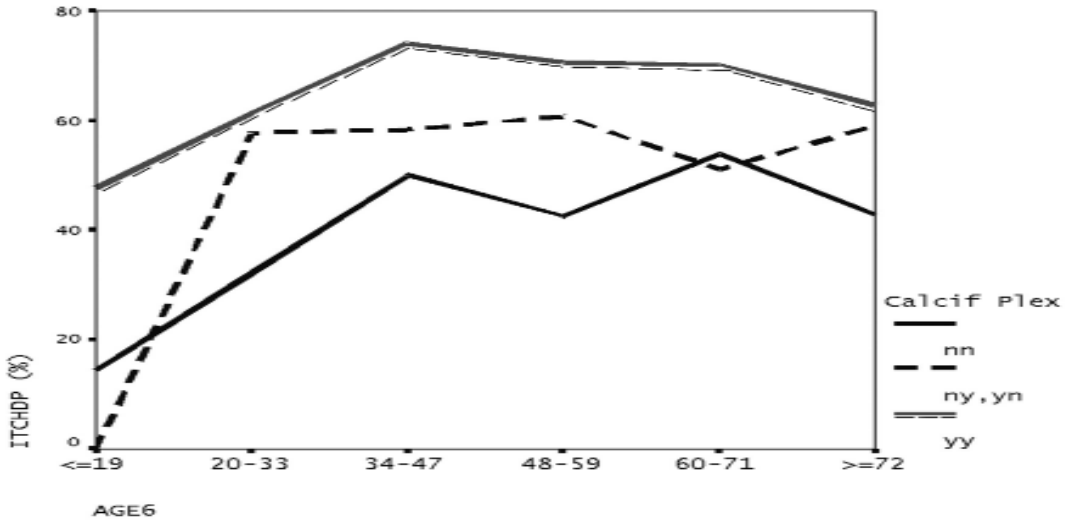

Figure 3. Frequency of the pineal gland calcification reported to age groups (comparative presentation with the calcification types [1)] of the choroid plexus [2)].

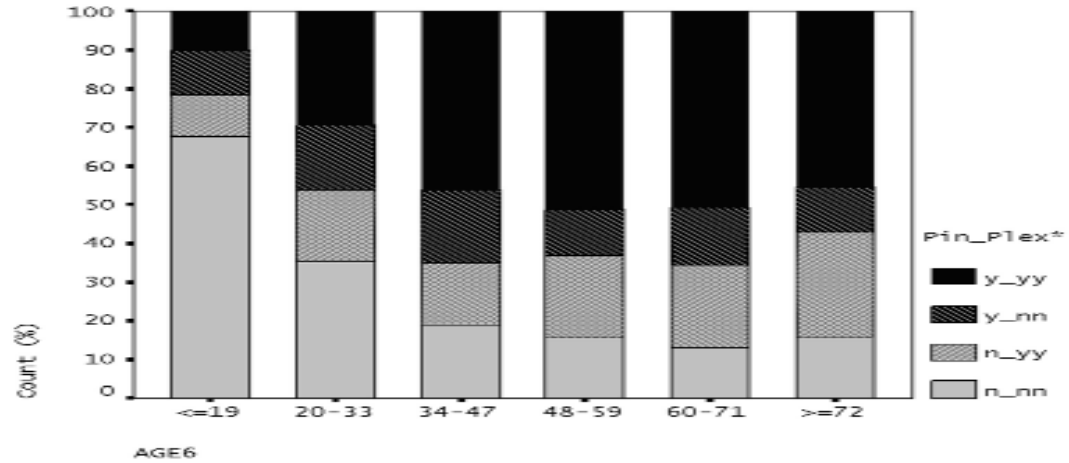

Figure 4. Distribution of the typology "Bilateral calcification of the choroid plexus - pineal calcification", on age groups (100%=total number of patients in the respective age category).

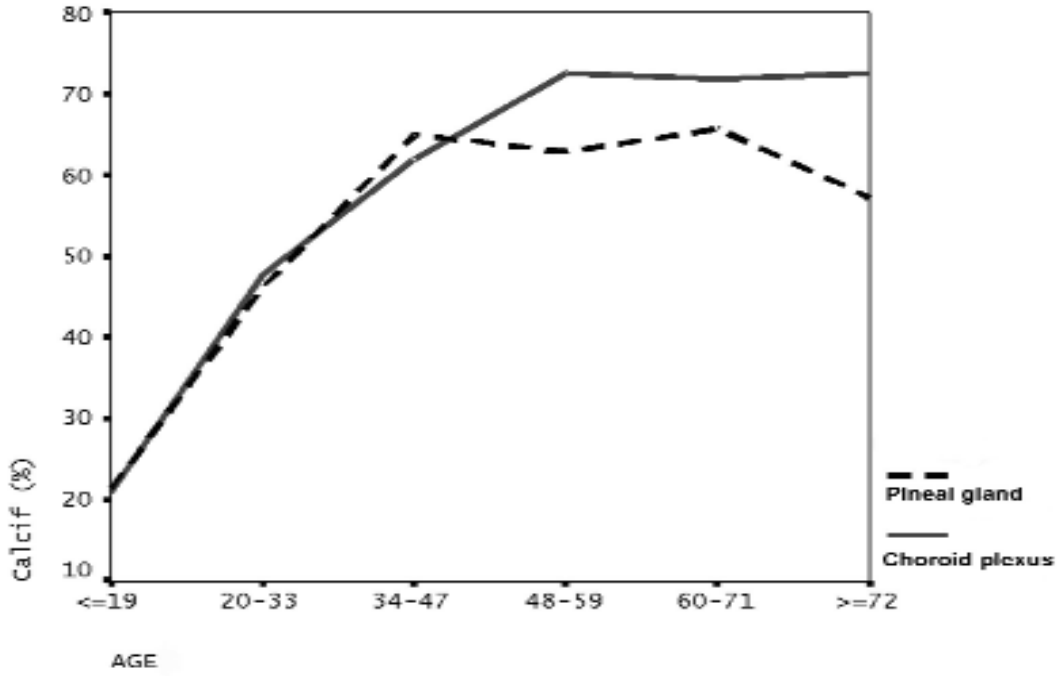

Figure 5. Comparative presentation of the calcification of the pineal gland and of the *bilateral* calcifications of the choroid plexus irrespective of sex and diagnosis.

DISCUSSION

Frequencies of the PG and CP calcifications are nearly equal until the age of 50, after this age the frequency of PG calcification stays nearly constant. The frequency of bilateral calcification of the CP grows up to 60 years of age, over which it stays nearly constant (!), as resulted from Fig 2.

Table 4 offers a statistical synthesis image of the studied interface phenomenon. We can thoroughly, comparatively analyze, on diagnosis categories, in each cassette, the frequencies of different variants of calcification correlative on line, column or diagonally, as well as globally.

We signal hereby only the following:

– the general phenomenon of calcification significantly differs among diagnosis groups;

– for the CCT, E and ICEP we can notice the association of calcifications, the frequencies of y_yy and n_nn categories are maximal;

– for N and S, the frequency of n_nn category is significantly smaller than for the other categories.

As we found in the specialized literature a paper with a similar subject, we will keep for conclusions only the results that seemed to mark the originality of our study, by anthropological particularities, hoping that after its impact with specialists in medical practice the other aspects will be studied more thoroughly and valorized more effectively.

In order to have a final image of the physiological typology that we proposed for observation and diagnosis in cranial CT investigations, we remind the fact that from the point of view of intra-cranial physiological calcification regarding the PG-CP couple, we found the following maximal frequencies for the four of the eight types in Table 2. The other four unilateral calcifications 2 (n-yn), 3 (n-ny), 6 (y-yn), 7 (y-ny) were not submitted to a detailed analysis.

As such, for:

type 1 (totally non-calcified n-nn) the maximal frequency is around 70% at the age group under 19 and minimal around 15% at the group 60-71;

type 8 (totally calcified y-yy, bilaterally) maximal frequency is around 50 % at the age groups 48- 59 and 60-71, and the minimal is around 10 % at the group under 19;

type 4 (n-yy, only CP calcified**)** presents a continuous increase from around 10% at the first age group to around 25 % at the last group, while **type 5 (**y-nn, only PG calcified) oscillated between 10 % and 20%.

It is important to signal the fact that the last group of age of over 72 does not constitute an extreme limit for signaled frequencies, therefore, even if the calcification process is physiological and increases with age, age is not the main cause of calcification types, but a process of reactive-adaptative variability, given by the complex of variables sex - constitutional ground - neuro-endocrine context, etc.

We point out in the end the fact that our anthropological approach started from some main general ideas:

-the importance of calcification for the normal development of the body, bone system, which is a sort of *"hard"* of the body, as a deposit and source of Ca^{+} for its metabolism (6);

-the existence of a global functional unity, with the role *of "soft",* for the processes in the human body and especially for the calcification phenomenon. We can scientifically explain today the fact that this unity is formed by *the coexistence of its functional systems* whose interdependency is *cybernetically regulated* (6, 14);

-the existence, beside and in correlation with these cybernetical systems, of some integrative functioning means with the role of interfaces among different systems or components of the human body, where *complex, simultaneous integronical processes of homeostasis / adaptative optimization* (non-cybernetical) take place (2).

By finding the interdependence among the types of calcification of the ensemble of the two structures, we noticed the existence of an interface to which they belong, and which intervenes in the general process of calcium homeostasis. The adaptative function of biophysical-chemical association PG - CP can be illustrated by the phenomenon of involving the type of calcification in its transformation to pathology. For instance, for a person with maximal calcification y-yy, it is normal to have a more intense calcification in the entire body; comparatively for type n-nn, the same calcification can indicate a passage to pathology.

The demonstration of our hypothesis is based on the use of the concepts of system / interface **(**2) that we gave to the activity of the *choroid plexus and pineal organ* - the main target of our paper. The use of the interface concept similar to the one in CP technique and its link with the concept of system, which is the basis of modern biological and medical knowledge, brought a series of advantages.

Table 4. Frequency of bilateral calcifications of the CP and PG

Types of variables		**Plexus**	**Pineal**	**Total**
	Non-calcification/calcification			
Diagnosis	Left Right Frequency	n [2]	y [2]	
CCT	nn [3]	No	113	163
		%	34	49.1
	yy [3]	No	67	169
		%	20.2	50.9
	Total	No	180	332
		%	54.2	100
N	nn	No	25	49
		%	15	29.3
	yy	No	33	118
		%	19.8	70.7
	Total	No	58	167
		%	34.7	100
E	nn	No	51	69
		%	44	59.5
	yy	No	12	47
		%	10.3	40.5
	Total	No	63	116
		%	54.3	100
VCA	nn	No	35	61
		%	18.6	32.4
	yy	No	44	127
		%	23.4	67.6
	Total	No	79	188
		%	42	100
EP	nn	No	81	120
		%	31.3	46.3
	yy	No	41	139
		%	15.8	53.7
	Total	No	122	259
		%	47.1	100
Others	nn	No	22	29
		%	25.9	34.1
	yy	No	20	56
		%	23.5	65.9
	Total	No	42	85
		%	49.4	100

CONCLUSIONS

Even if the calcification process is physiological and increases with age, age is not the main cause of calcification types, but a process of reactive-adaptative variability, given by the complex of variables: sex - constitutional ground - neuro-endocrine context, etc.

We mainly mention the advantage of identifying the characteristics of some categories of phenomena in their essence of *communication, transitory, modulator-translator, real adaptive barriers among systems*, other than the *criteria of cybernetical regulation*. There are some bioelectrical metabolic activities taking place here, belonging to different types of homeostasis and whose functionality is a signal for normality or pathology. We considered that CP and PG take part in such interface integrative phenomena (2, 15). An example of the activity of such a biophysical-chemical interface is the almost perfect symmetry of the bilateral calcifications (crystal lamellar structures, concentric, in substrata non-dependent anatomically) from the symmetry centre given by the PG calcification.

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