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POROTIC HYPEROSTOSIS FROM PREHISTORIC PERIODS

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ABSTRACT

Porotic hyperostosis or symmetrical osteoporosis is the general designation of a bone deformation, the localization of which is the upper part of the orbit or the external surface of the cranium. It relates to three manifestations : light (porotic) ; scattered fine foramina ; medium (cribrotic) : large and small isolated foramina, and foramina that have linked to form a trabecular system ; severe (trabecular) : outgrowth in trabecular structure from the normal contour of the outer bone table. It is the author's opinion that porotic hyperostosis reflects and iron deficiency anemia, on the other hand genetic anemias (such as beta thalassemia or sickle cell anemia). The frequency of latter anemias can be quite small in an archeological samples. The anthropological elaboration in detail of Neolithic, Copper and Bronze Ages (as well as of the Kurgan Culture) originating from the territory of the part of the Great Hungarian Plain has already taken place. We have observed the three basic types (forms) of porotic hyperostosis. These occurred in a lower number. (This is primarily connected with the extremely fragmentary state of presentation of the prehistoric material). In the southern part of the Great Hungarian Plain the iron deficiency anemia can be responsible for the appearance of the porotic hyperostosis.

Key-words : Prehistoric periods - Porotic Hyperostosis - Iron deficiency - Thalassemia.

1 INTRODUCTION

Porotic hyperostosis or symmetrical osteoporosis is the general designation of a bone deformation, the localization of which is the upper part of the orbit or the external surface of the cranium. These deformations may be characterized by the attenuation of the cortical layer and, accordingly, by the thickening of the diploe. According to certain authors (Armelagos, 1967 ; Carlson et al, 1974) porotic hyperostosis relates to three special manifestations, meaning at the same time its three main types (Nathan and Haas, 1966), respectively its three phases (Stuart-Macadam, 1985) : light (porotic), medium (cribrotic) and severe (trabecular).
These three forms can be traced back to one uniform course of disease, occurring also some transistory forms besides the above-mentioned phases. The morphological differential diagnosis of bone deformations is the following (Marcski-Kosa, 1976) :

Age, both at males and females, the Mediterranean group occurs most frequently, in importance of these is, however, decreased. The cause of this is, first of all, the numerical increase is Nordoid, Cromagnoid and Brachycranian ones. At males, the most frequent variation is the Nordoid, at females the Mediterranean one (Farkas, 1977). The anthropological picture of the Kurgan culture is primarily characterized by Cromagnoids which are, however, marked by their massive, strong features, mainly concerning the glabella and the arcus superciliaris (Marcsik, 1979). Following the investigations of Toth (1977), on the basis of the applied comparisons, in the Middle-Danube Basin, in the Neolithic, Copper and Bronze Ages, two main morphogenetic trends are outlined (SE-NW and NE-SW). Though, the morphological consequences of immigrations from the upper-Danube region may be observed in the course of the Bronze Age, as well, the morphogenetic effects of the Eastern Mediterranean have increased and, as a result of the repeated infiltrations, in the anthropological spectrum of the paleometallic population of the southern part of the Great Hungarian Plain the character-complexes of eastern origin became more determined. This was well expressed in the decrease of gracility. According to the archeological opinion, in the Neolithic period, the Carpathian basin was occupied by a new agricultural population, probably from the direction of the Balkan Peninsula, from South or South-East. This supposition can be supported with anthropological data, as well, but a migration, arrived from the East, is not excluded, either. The Copper Age population in the southern part of the Great Hungarian Plain is a southern origin. This is proved by the approximately 49 per cent frequency of Mediterraneans but the Brachycephals appeared in this age, as well. Concerning the Bronze Age, the followings were established. The archeological observations concerning the peoples of the Carpathian Basin in the early Bronze Age from southern and eastern directions can be supported in the southern part of the Great Hungarian Plain by anthropological data, as well. It seems to us that the peoples arriving from the East may have had a greater importance. The data from the southern part of the Great Hungarian Plain correspond to the archeological observations of the Middle Bronze Age, the Balkanic influence is verified. On the other hand, there are but few finds concerning the Late Bronze Age for establishing any conclusions of such character (Farkas, 1977). The parallels of the massive, sharp-featured archeomorph Cromagnoid character can be found in the individuals of the Kurgan culture in Ukraine, Rumania. These are of eastern origin, their expansion coming from ukraine is well-known (Marcsik, 1979).
In the series belonging to these prehistoric cultures, the surgical trepanation could be observed in more than one case. There occur in a comparatively high frequency the anatomical variations, developmental anomalies, while in pathological relation but a few deformations could be found (Farkas, 1977). We have also observed the three basic types (forms) of porotic hyperostosis (fig. 1, 2, 3, 4). These occurred in a lower number. (This is primarily connected with the extremely fragmentary state of presentation of the prehistoric material). The establishment of exact statistical data would be inexpedient. New data on porotic hyperostosis was obtained from the analysis of 40 crania from the Late Neolithic period, of 16 from the Kurgan culture, and of 408 crania from Bronze Age (Table).

a. The initial form of the process is the so-called porotic type (light form). The lamina externa became thinner, that is resorbed. The spongiosa is formed by identical cellules but in the site of localization, the medullary spaces grow wider and the partial resorption, reorganization of trabeculae can already be observed. As a result of resorption, the unequally wide medullary system opened towards the outer world. The main sites of localization are the upper part of the orbita, the nuchal part of os parietale.

b. The cribriform type (medium form) is the following phase of the process. The deformations are more expressed than the porotic (light) ones, but this form, too, is characterized by the same courses of the disease. The hyperplasia of the spongiosa takes place to the detriment of the lamina externa. As a result of the hyperplastic deformations, the walls of the trabecules forming cellules also become thin and, as a result of the bone resorption and apposition, much more medullary cavities than the normal ones come into being. The secondary resorptive process in the cortical layer progresses by the transformation of the spongiosa, parallel with the medullary rearrangement. The main field of its appearance is the orbital roof or os parietale.

c. The hyperplasia of the spongiosa may be considered as the most severe form of the course of the disease, being localized either on the orbital roof or os parietale, os frontale. The compact substance is a "coral-like" and the spongiosa is a "mush-room-like". The opened medullary cellules are shaped in the form of canals perpendicularly to the surface. Presumably, the growing of trabeculae in the direction of the surface plays a part in this, as a secondary reaction completing the medullary hyperplasia. The trabeculae-ends are free, the cellules on the surface are alongated. The diploe has two layers. The inner layer has a normal structure, while the lamellae of the outer layer are longer than the medium ones ; they are generally placed perpendicularly to the surface and the medullary places limited by them are widened in an extreme degree.
As the three symptoms - on the basis of the relevant medical and paleopathological data (Lie-Injo, 1958 ; Moseley, 1961, 1965) - may be considered like a uniform pathological process, the primary and secondary diseases of the hematopoietic system can be regarded unequivocally as their etiology. The authors explain them with one kind of the hemolytic anemia (mainly beta thalassemia)(Angel, 1964, 1966), on the other hand, with the iron deficiency anemia (Hengen, 1971 ; El-Najjar et al, 1975 ; Carlson et al, 1974 ; Lallo et al, 1977, and so on).

2 MATERIAL AND METHOD

The anthropological elaboration in detail of the material of Neolithic periods, Copper and Bronze Ages, as well as of the Kurgan culture, originating from the territory of the part of the Great Hungarian Plain has already taken place (Farkas, 1977 ; Farkas-Marcsik, in press ; Marcsik, 1979). On the basis of the taxonomical analysis in the Neolithic period, at males primarily the Nordoid (it is a hybrid type), at females the Mediterranean types occur. In the Copper Age, at males the ratio of Nordoid ones decreases, the frequency of Mediterranean and Cromaghoid ones increases. As compared with the Neolithic period, at females no essential difference can be seen. In the Bronze

3 DISCUSSION AND RESULT

The phenomenon of porotic hyperostosis has been described from different geographical territories, related to different archeological ages by a high number of authors.

Angel (1964) emphasizes the geographical dispersion of the abnormal hemoglobins and explains the cases of the porotic hyperostosis with the dispersion of the Plasmodium falciparum. The malarial fever was endemic B.C. 2000 years in the eastern part of the Mediterranean, the thalassemic heterozygotes proliferated because they offerred resistance to the malaria. Thus, the porotic hyperostosis increased on the old malarial regions, in Sardinia, Sicily, Greece, etc. In Corint (Bronze Age), the skeletons of eleven children have shown the phenomenon of porotic hyperostosis. The bone deformation corresponds to the hemolytic anemia. But Angel agrees with Moseley, as well as with Nathan-Haas in that in case of certain crania the destruction was induced by anemia originating from the nourishment.

Ascenzi and Balistreri (1977) clearly showed that the thalassemia was introduced into Italy by the Greek colonist in the 6th and 8th centuries but they did not contest its origin from the paleolithic period.

Hillson (1980) described both cribra orbitalia and cribra cranii in the crania excavated from the Nile valley and called the attention to the anemia induced by parasites, as a possible etiology.

El-Najjar (1976 and El-Najjar-Robertson, 1976) described several cases from America, explaining with the malnutrition or unilateral nourishment, with consuming permanently either corn or beans or maize. It is well known that corn and beans have a high carbohydrate content but they are fully in lack of ascorbic acid. Both corn and beans are generally cooked for a long time. This distroys folic acid and vitamin B12 almost in 90 per cent, which are indispensable to the development of erythrocytes. The iron content of maize is comparatively low and it contains, at the same time, a large of phytic acid, which prevents iron from being absorbed.

Janssens (1981) has observed the phenomenon of cribra orbitalia in the Bronze Age matter of Northern Europe, in case of burnt crania. In his opinion, these can't be brought into connection with thalassemia because Falciparum malariae was not native in Northern Europe in the Bronze Age. As in the graves a large amount of bone remains of goats was found, he has arrived at the conclusion that the hypoferric anemia and secondarily the porotic hyperostosis may have been caused by the standing consumption of goat's milk.
The hemoglobinopathies are showing a geographical localization ; their distribution is not as general as that of the iron deficiency anemia. The gene of thalassemia may anymway be imported by an immigration from the South, this however, could not be distributed. The children sufferring from thalassemia major (a state of homozygote), die in their early childhood. A secondary bone deformation, formed in this disease, the hyperostosis spongiosa may be seen in this material, in crania belonging to a higher age of life, as well. The thalassemia minor (a state of heterozygote) does not induce bone phenomena. It can't be responsible for the cribra orbitalia that is a comparatively

Porotic Hyperostosis from Prehistoric Periods

Age	Sex	Types		
		porotic (light)	cribrotic (medium)	trabecular (severe)
Neolithic Period				
Inf. I. 1	–		+	
Inf. II. 1	–	+		
Juv. 1	female		+	
	female		+	
Ad. 2	male	+		
Total : 5 (12,5 %)				
Kurgan Culture				
Inf. I. 1	–	+		
Inf. II. 1	–		+	
Total : 2 (12,5 %)				
Bronze Age				
Inf. I. 2	–	–	+ (1)	+ (1)
Inf. II. 7	–	+ (5)	+ (2)	–
Juv. 3	–	+ (2)	+ (1)	–
Ad. 21	male : 10	+ (5)	+ (4)	+ (1)
	female : 11	+ (10)	+ (1)	–
Mat. 8	male : 4	+ (3)	–	+ (1)
	female : 4	+ (4)	–	–
Total : 41 (10,1 %)		29	9	3

higher frequency and is characteristic of the material of every archeological period.
The phenomenon of the porotic hyperostosis was also described in crania originating from the Prehistoric Age of Mexico, South America,i.e. from the territories, where the hemoglobinopathy was not known before the immigration from Europe (El-Najjar et al, 1975).
At present, the thalassemia is frequent in every region of the Mediterranean and beyond this in Syria, Iran, Afghanistan, Indochina, the Philippine Islands, China, New-Guinea. Some draw the conclusion from this geographical distribution that this anomaly originates from the vicinity of the Mediterranean or from China (Lehamnn-Huntsman, 1966). But the connection between the beta thalassemia and the malarial endemic areas should still be completed on the basis of the present day results of the investigations into hemoglobin variants and population genetics. It cannot be taken as sure that thalassemia and the lack of G6PD give a relative immunity against being infected by malaria falciparum, though in lack of G6PD, the erythrocytes of low reduced glutathion content probably mean a less favourable environment for the malaria plasmodium. The argument that while the frequency of the gene of beta thalassemia and of the lack of G6PD is high in the seaside regions with malaria endemy but it is low in the malaria-free highland villages, speaks for the selective advantage ensured by the beta thalassemia and G6PD (Hollan, 1972). The same was investigated by Plato et al. (1964) in Cyprus. They similarly found so that on the mountain Troodos the incidence of the malaria, the lack of G6PD and thalassemia was frequent ; in the seaside regions, however, all the three diseases were frequent. At the same time, it turned out, as well, that there was a great difference in respect of the characteristic of blood groups ABO, Rh, MNSs, and Fy between the population of the mountain Troodos and of the seaside region. The cause of the heterogeneity of blood groups is rooted in the ethnical origin of the population. The heterogeneity the frequency of the distribution of blood group genes refers to that the frequency of the thalassemia and the lack of G6PD may in the same way originate from the ethnical heterogeneity as from the endemic-malaria induced natural selection.
For the appearance of the porotic hyperostosis in the prehistoric material, in the southern part of the Great Hungarian Plain, is also the iron deficiency anemia to be held responsible, although in the Bronze Age population of the Mediterranean the hyperostosis spongiosa (trabecular type) may have been induced by the thalassemia.

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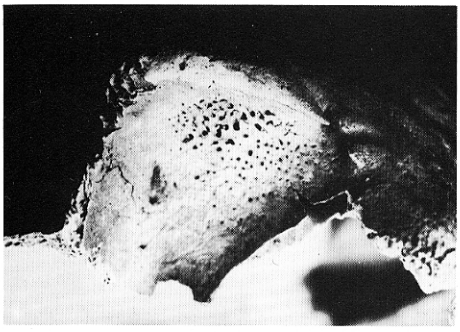

FIGURE 1 : Cribra orbitalia / porotic-cribrotic type / Tápé 3712/518, Bronze-Age

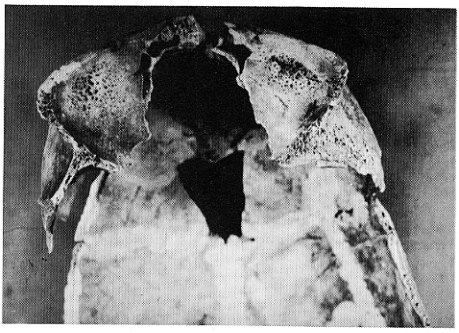

FIGURE 2 : Cribra orbitalia : Trabecular type on the left side
Tápé 3712/518, Bronze-Age

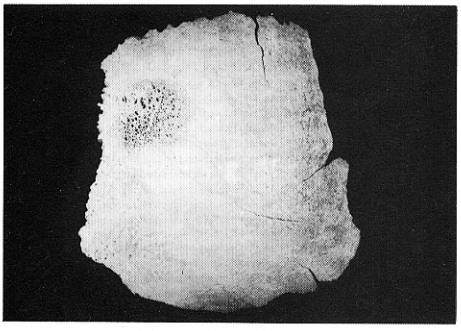

FIGURE 3 : Cribra cranii
Szolmok 3507, Bronze-Age

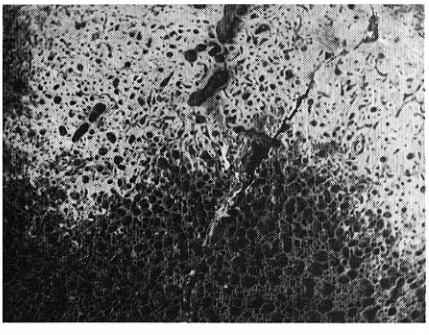

FIGURE 4 : Hyperostosis spongiosa cranii

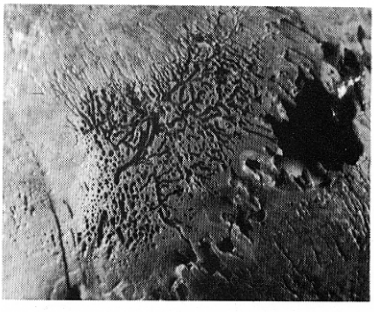

FIGURE 4 : Szöreg-C 271/167, Bronze-Age