

## Etiopathogenesis of hyperostosis frontalis interna: A mystery still

Athanasios Raikos<sup>a,b,\*</sup>, George K. Paraskevas<sup>b</sup>, Faisal Yusuf<sup>a</sup>, Panagiota Kordali<sup>b</sup>, Soultana Meditskou<sup>c</sup>, Abdulatif Al-Haj<sup>a</sup>, Beate Brand-Saberi<sup>a</sup>

<sup>a</sup> Department of Anatomy and Molecular Embryology, Medical Faculty, Ruhr University, Bochum, Germany

<sup>b</sup> Department of Anatomy, Medical School, Aristotle University of Thessaloniki, Greece

<sup>c</sup> Laboratory of Histology, Embryology and Anthropology, Medical School, Aristotle University of Thessaloniki, Greece

### ARTICLE INFO

#### Article history:

Received 4 January 2011

Received in revised form 28 April 2011

Accepted 7 May 2011

#### Keywords:

Cadaver  
Dura mater  
Falx cerebri  
Hyperostotic nodules  
Ossification  
Pathogenesis

### ABSTRACT

Hyperostosis frontalis interna is a morphological pattern characterized by single or multiple bony nodules situated on the inner lamina of the frontal bone. It is seldom found in males, but it is a common phenomenon among post-menopausal females in modern societies but relatively rare in antiquity. The etiopathogenesis of the trait is a matter of debate and ranges from genetic predisposition to epigenetic, while endocrine disturbances, aging, and dietary factors are also listed among the causes. We studied the frequency, characteristic features, and etiopathogenesis of the disease in recent cadaveric and dry skull specimens. The frequency of hyperostosis frontalis interna in cadavers and dry skull materials was almost identical, 12.5% and 12.3%, respectively. In cadavers, 87.5% of severe hyperostosis frontalis interna cases were found in females over 65 years-old. Interestingly, in two cadavers we found hyperostotic lesions spreading onto adjacent tissues such as the dura and falx cerebri. We provide some new aspects that may help in better understanding of the etiopathogenesis of hyperostosis frontalis interna. Thereby, we discuss the various etiopathogenesis models found in the literature.

© 2011 Elsevier GmbH. All rights reserved.

### 1. Introduction

Hyperostosis of the cranium refers to a set of endocranial pathological features, each having an independent etiology, varied histopathological findings, and localization. Hyperostosis frontalis interna (HFI) is characterized by the presence of a single or, more frequently, multiple nodules localized bilaterally on the inner lamina of the frontal bone, while most of the diploë and external lamina of the bone remain unaffected. The calvarial midline is usually spared even in the most severe cases (Moore, 1936a; She and Szakacs, 2004; Talarico et al., 2008). HFI was firstly described by Morgagni in 1719 as a pathology accompanying obesity and virilism (Morgagni, 1719). HFI can be encountered in relation to many other syndromes such as: Troell–Junet (acromegaly, thyrotoxicosis), Stewart–Morel (mental disease, obesity), Paget's (enlarged and deformed bones), Frölich (obesity, growth retardation, pituitary hypocrinism), and Klippel–Trenaunay–Weber (varicose veins,

port-wine stain, bone and soft tissue hypertrophy) (Anton, 1997; Hershkovitz et al., 1999). However, it was acknowledged that it can also occur as an independent entity (Caughey, 1958; She and Szakacs, 2004).

The normal calvarium is composed of cortical bone in the external lamina (exocranium), compact bone in the inner (endocranium), while trabecular bone lies between them (diploë). There is no statistical difference between males and females in diploic thickness, except the frontal bone in males. Furthermore, no correlation exists between diploic thickness and age, height or weight (Lynnerup et al., 2005). HFI is usually encountered more frequently in elderly females (Henschen, 1949; Moore, 1936a; Hershkovitz et al., 1999) and occurs rarely in males (Nikolic et al., 2010). It seems that every reported case in males was related to severe hypogonadism and testicular atrophy (Caughey, 1958; Perou, 1964; Yamakawa et al., 2006).

The severity of HFI varies greatly in shape and size, and can be classified using radiologic (indirect) or histological (direct) methods. Barber et al. (1997), designated radiological criteria and graded the appearance of HFI in plain radiographs: Grade I, featured by early bone formation in the endocranium; Grade II, prominent bone thickness and roundish appearance of nodules on the inner calvarial plate; while in Grade III, the thickness of the endocranium is extensive and shows an irregular pattern of nodules. Hershkovitz et al. (1999), in order to establish an accurate identification of the severity of HFI, proposed a classification grouping the four types

*Abbreviation:* HFI, hyperostosis frontalis interna.

\* Corresponding author at: Department of Anatomy and Molecular Embryology, Medical Faculty, Ruhr University of Bochum, Geb. MA 5/158, Universitätsstr. 150, 44801 Bochum, Germany. Tel.: +49 0234 32 27780.

*E-mail addresses:* [a.raikos@yahoo.com](mailto:a.raikos@yahoo.com) (A. Raikos), [g.paraskevas@yahoo.com](mailto:g.paraskevas@yahoo.com) (G.K. Paraskevas), [faisal.yusuf@rub.de](mailto:faisal.yusuf@rub.de) (F. Yusuf), [kordalig@yahoo.gr](mailto:kordalig@yahoo.gr) (P. Kordali), [meditskou@gmail.com](mailto:meditskou@gmail.com) (S. Meditskou), [alhajj@hotmail.de](mailto:alhajj@hotmail.de) (A. Al-Haj), [beate.brand-saberi@rub.de](mailto:beate.brand-saberi@rub.de) (B. Brand-Saberi).

according to morphologic and histopathologic characteristics of the endocranium: Type A, single or multiple isolated bony elevations under 10 mm in diameter located on the endocranial surface of the frontal bone; Type B, nodular bony formations occupying less than 25% of the frontal bone; Type C, same as B but nodules covering up to 50% of the frontal bone; Type D, continuous nodular bony overgrowth involving over 50% of the frontal endocranium. The aim of our investigation has been to interpret HFI findings in dry and cadaveric skulls of body donors, to comment on the pathogenesis of the various traits, and to advance our understanding of the models proposed over the years.

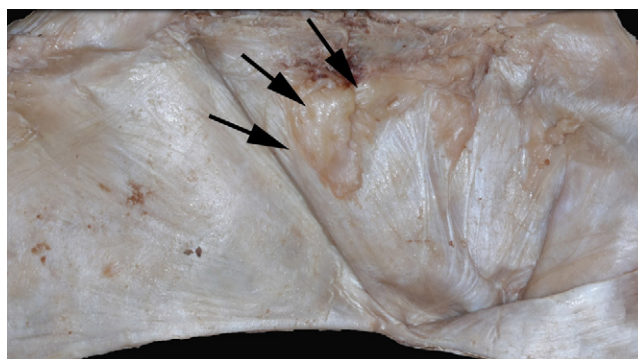
## 2. Materials and methods

For the purpose of this study, 204 dry skulls (107 male and 97 female) from our recent osteological collection (aged 20–94 years at death), and 40 formalin embalmed cadavers (18 male and 22 female), were dissected with an oscillating bone saw, and examined for the presence of irregular bone patterns on the inner lamina of the calvarium. Both cadaveric and dry skull bones belonged to members of the Caucasian ethnic group from the central and southern Europe region, and had been born during the 20th century. In the cadaveric specimens, special care was taken during calvarial dissection and removal to preserve the underlying structures such as the meninges and cerebrum. In addition, the meninges were inspected for the presence of ossification lesions and resected along with the brain in order to expose the cranial fossae. Measurements were obtained using a Vernier digital sliding-caliper (Mitutoyo Co., Japan), accurate to 0.1 mm.

The severity of HFI was classified according to the four types proposed by Hershkovitz et al. (1999). The specimens were classified into three age groups (18–39, 40–64, and >65), the young, middle, and the old age group. Histological samples were taken bilaterally in cases of macroscopic recognition of HFI with the use of narrow saw blades, then prepared and stained according to a previously described technique according to Talarico et al. (2008). The cadavers were free of any other bone related pathology, and no history of brain tumor or meningioma was present.

## 3. Results

The total frequency of HFI in both cadaveric and dry skull specimens was 11.9%. The frequency in cadavers was 12.5% (22.7% in females, 0% in males). The presence in the older age group among the cadaveric specimens was 28.6% (Table 1), whereas the severity of HFI in female cadavers and dry skulls is correlated with an increase in age ( $r=0.99$ , and  $0.97$  for cadavers and dry skulls, respectively). 87.5% of Type D cases were over 65 years in age. Interestingly, in an 83-year-old female cadaver an irregular pattern of the inner frontal calvarial lamina was noted. The frontal bone was covered bilaterally by continuous multiple small and medium sized hard nodules, organized in groups. During the inspection of the falx cerebri, a hard dense sphenoid-shaped lesion 1.9 cm long and 1.5 cm wide was noted, corresponding to the level of the coronal suture, whereas it transversed the dura from one side to the other (Fig. 1). The borders were smooth and regular. Interestingly, histological study revealed that the composition of the dense mass was bone with a pattern similar to that of HFI (Fig. 2). The possibility of epidural fibrous tumor or fibromatosis due to abscess or hematoma was excluded due to the different histopathological pattern, localization and medical history. The irregular calvarial bone pattern could be sorted as Type D according to Hershkovitz et al. (1999) classification model, however, the rare hyperostotic finding at the falx cerebri could not be classified to any of the known types and was designated as Type E (Table 1). In a second case, in

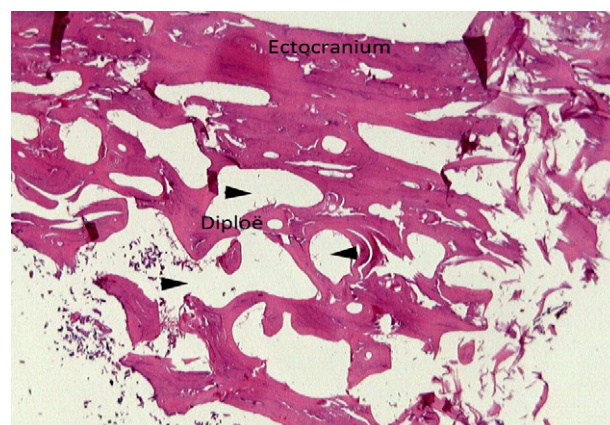


**Fig. 1.** Hard dense sphenoid-shaped lesion (arrows) 1.9 cm long and 1.5 cm wide on the falx cerebri at the level of the coronal suture. The nodule perforates the dura on both sides.

a 79-year-old female with severe HFI (Type D), the dura covering the frontal bone was ossified and elevated on the left of the anterior cranial fossa (Fig. 3a and b). The inferior segment of the frontal lobe was squeezed as a result of the evoked compression (Fig. 4). The frequency of HFI in female dry skulls was 20.6%, while only three cases were found among the 107 male dry skulls. In males, two of the cases belonged in the old and one in the middle aged group (Table 2). The severity of the trait in males was limited only to Types A and B.

The hyperostotic nodules were round or oval shaped and their caliber ranged from a few millimeters to 14 mm, while the protrusions from the physiological border of the endocranium ranged from 1 mm to 19 mm. The midline of the horizontal portion of the calvarium was spared in all the studied cases, however in severe cases the vertical portion was occupied by hyperostotic lesions (Fig. 5). Some small roundish and/or irregularly shaped nodules were noticed on the inner lamina of calvarial bones other than the frontal (usually the parietal bone) in 3 out of 29 of total specimens with HFI (10.3%) (Fig. 6). In all cadaveric specimens, the dura mater had the tendency to adhere in hyperostotic areas, while in some instances it was firmly attached between nodule islets (Fig. 5).

Histopathological studies of the HFI nodules indicated that the external lamina of the frontal bone presented a typical morphology, while an increase in cancellous bone in the diploë was present. The marrow cavities along with bony trabeculae had an irregular shape and size pattern. The endocranial plate exhibited extensive remodeling similar to that of the diploë, whereas the lamella of



**Fig. 2.** Histological section of the bony nodule perforating the falx cerebri. Bone marrow cavities and bony trabeculae show extensive remodeling. Ectocranium with dense bone. Increase in cancellous bone in the diploë, the marrow cavities have an irregular shape and size pattern (arrowheads). Magnification: 40 $\times$ , paraffin section at 6  $\mu$ m, stain: H + E.

Download English Version:

<https://daneshyari.com/en/article/8461961>

Download Persian Version:

<https://daneshyari.com/article/8461961>

[Daneshyari.com](https://daneshyari.com)