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Extensive ossifications of falx cerebri – literature review based on own experience and case report

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Running headline: falx cerebri ossification

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Abstract

Extensive ossification of the falx cerebri occur rarely however are described in the world literature references. Ossifications may concern both cerebral falx and other dural structures: tentorium. They are most often incidental findings and occurrence frequency in the population is remains unclear. The authors of the study are reviewing references on this subject, based on a case of extensive falx ossification. Manuscript describes the case of incidental detected of extensive calcification of the anterior brain sickle in a patient after head injury. Computed tomography revealed no pathology, but extensive ossification of falx was described. The patient did not complain of any significant complaints or neurological symptoms. The described calcification constituted a median and sagittal bone or calcium plate separating the frontal lobes of the brain. Analyzing references did not identify such extensive ossification of falx cerebri in human, however dural ossifications are reported in the references.

Key words: falx cerebri, ossification, dura

Background

The ossifications and calcification of the dura mater structures are described in the references of anatomical, neurosurgical and radiological literature. Most often, such ossifications concern cerebral falx and cerebellar tentorium [1]. Apart from the dura mater structures, such calcifications may occur intracranially within the pineal gland and thalamus [1,2]. They may also involve the choroid plexus of the lateral ventricles. Most often, such ossifications or calcification are clinically irrelevant and cause no neurological symptoms: neither focal deficit symptoms nor irritating symptoms - epileptic seizures [1-3]. They also do not cause increased intracranial pressure. Most often they are accidentally diagnosed during head imaging examinations performed for various medical indications. The imaging test of choice,

which most clearly shows ossification is computed tomography (CT) [3]. In CT, calcifications are clearly distinguishable from brain tissue and cerebrospinal fluid because they are definitely hyperdense. Their density is close to that of the bone tissue. However, in magnetic resonance imaging (MRI) they are indistinct [3]. Calcification or bone tissue has a density of around 1000 Hounsfield units (HU), the brain has 30-45 HU, and blood has 70 HU [1,3]. Calcification and ossification of falx should be differentiated from calcified meningiomas, osteomas, calcified pericallosal artery aneurysms. This requires each time to differentiate whether there is only a ossification as an anatomical variant, or it is a ossified or calcified pathological lesion that requires neurosurgical treatment [4].

Case presentation

In this manuscript, the authors describe the case of a 71-year-old female patient admitted to the Department of Neurosurgery, Neurotraumatology and Pediatric Neurosurgery of Ludwik Rydygier Collegium Medicum in Bydgoszcz of Nicolaus Copernicus University in Toruń in Poland. Patient was admitted due to a minor head injury. The physical examination did not reveal any neurological abnormalities, and the patient did not complain of any significant symptoms. Head CT scan showed extensive sickle brain tussling, and no intracranial pathology was found. This ossification was considered an anatomical variant. CT scan imaging the ossicles in Figure 1.

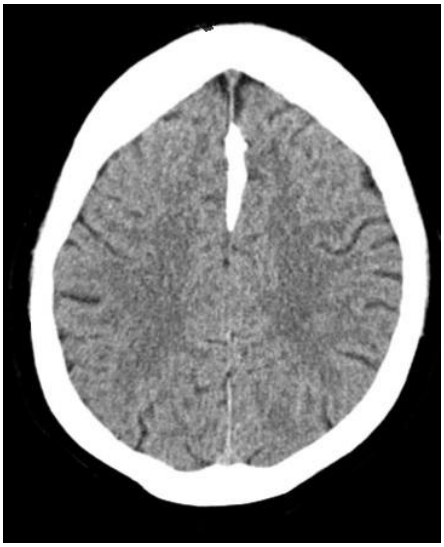

Fig. 1. Ossification of anterior part of falx (CT scan)

Discussion

In our manuscript, the term ossification, not calcification, was used to describe the examined anatomical variant. However, the differentiation between calcification and ossification can only be made on the basis of histopathological examination and assessment of whether there are elements of bone tissue. Batnitzky et al. (1974) coped with the differentiation between calcification and ossification and points out that in discussing mineralization of the falx cerebri many radiology textbooks use the term calcification and make no mention of ossification [5]. In his study Batnitzky et al. performed a retrospective study of 18 consecutive autopsy cases, in which skull radiographs had revealed mineralization of the falx, was undertaken [5]. These areas of mineralization were excised and submitted for histological evaluation. The density seen on the skull radiograph consisted of membranous bone complete with bone marrow elements in all cases [5]. Most relevant conclusion, based on report by Batnizky was that the correct name for such changes as described in our manuscrpit is ossification, not calcification. Dural ossifications have held the interest of pathologists and anatomists for many generations, and the numerous authors have investigated this subject. Already 100 years ago, because in 1923 Halstead A. and Christopher F. described such changes on the basis of animal model and stated that bony new growths in the dura are found frequently in the animal kingdom [6]. They are presented in the falx of the dolphin, the seal, the platibus and in the tentorium of cats, bears, horses and pachyderms [6]. Tubbs R. S. et al. (2006) described a case of complete ossification of the falx cerebri [7]. In his study during the routine dissection of the head and neck of an adult male cadaver complete ossification of the falx cerebri was noted. Anomalous ossification was not found in any other dural component or other parts of the body. [7] The brain appeared grossly normal. Histological sections showed normal ossification processes involving the falx cerebri [7]. In contrast to our study, Tubbs et al. described total ossification of the falx, not just its anterior part. An example of similar to our report ossification of the anterior part of the falx was reported by Debnath J. (2009). He described a case of extensive ossification involving anterior half of the falx cerebri in a 47-year-old male [8]. Morphology of ossification described by Debnath was similar to our case. In study of Debnath falx ossification was detected incidentally during computed tomographic examination of the brain for an unrelated cause [8]. The pattern of ossification comprised of dense cortical bone peripherally with medullary bone in the centre resembling the skull vault [8]. Another significant item in the literature about falx ossifications was the

study of Al-Motabagani et al. (2004). It was cadaveric study based on two human formalin-fixed cadavers, one middle-aged female and older male [9]. Calcified or ossified tissues, when identified, were subjected to histological examination to confirm their construction. Al-Motabagani revealed that dural calcifications or ossifications of dura might occur in population [9]. Ossifications could be observed as incidental findings in imaging studies and autopsy. Al-Motabagani emphasised that these changes should be kept in mind while interpreting images of the skull and brain [9]. According to his conclusions clinical assessment and laboratory investigations are required to determine whether these changes are idiopathic, traumatic, or as a manifestation of a generalized disease such as hyperparathyroidism, vitamin D-intoxication, or chronic renal failure [9]. In turn, Rao et al. (2007) indicated in his study that awareness of anomalous ossification of the falx cereberi must have been useful guide for both in studies of human anatomy and in clinical practice. Rao emphasised significant practical importance for the neurosurgeons and radiologist, to know the form, degree of severity and range of extension of ossifications [9]. According to his conclusions neuroimages with such ossification patterns might lead to confusion in interpretation [9] and the relations of ossification with neighboring brain tissue, blood vessels and other intracranial structures were important for an accurate diagnosis and to prevent further surgical complications during routine surgery [9]. According to Rao et al. (2007) head CT images of with such ossification patterns may lead to confusion in interpretation [10]. The relations of this ossification with neighboring brain tissue, blood vessels and other structures are important for an accurate diagnosis and to prevent further surgical complications during routine surgery [10]. Usmani et al. (2019), in turn noted in his manuscript that cerebral falx ossification has been an incidental finding and should be distinguished from calcified meningioma, hematoma, and meningeal infiltration [11].

Conclusions

1. The proper nomenclature to describe such changes seems to be the term: ossification, not calcification. This is due to the literature data providing the presence of morphotic elements of bone tissue
2. Ossifications of dura mater and its structures: falx cerebri and tentorium cerebelli are described in the literature as incidental findings that do not cause clinical symptoms, although extensive ossifications are always casuistic and are described as case reports

Abbreviations

- CT – computed tomography
- HU - Hounsfield units
- MRI - Magnetic resonance imaging

Declarations

• Ethics approval and consent to participate: The experiment was approved by the Bioethics Committee of the Ludwik Rydygier Collegium Medicum in Bydgoszcz (KB 35/2020). Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

• Consent for publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

• Availability of data and materials: All relevant data are within the paper.

• Competing Interests: The authors declare that they have no conflict of interest.

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• Authors' contributions: ZS treated this patient, noted the presence of ossification, therefore he came up with the idea of describing a case. ZS, BG, JW analyzed and interpreted the patient's data. ZS and KJ, KH performed analysis of ossification. ZS was a major contributor in writing the manuscript. ZS, BG, JW, KJ and KH reviewed the literature about similar ossification. MS checked the written manuscript in formal terms. All authors read and approved the final manuscript.

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References

1. Jassim M. H., George N. T., Jawad M. M. (2019). Radiographic Anatomical Study of Intracranial Calcifications in Patients underwent Computerized Tomography Imaging.
2. Xu Z., Su C., Xiao Y. (2013). A massive calcification and ossification of the transverse sinus and the neighbouring dura mimicking meningioma. BMC neurology, 13(1), 143.
3. Tsitouridis I., Natsis K., Goutsaridou F., et al. (2006). Falx Cerebri Ossification: CT and MRI Evaluation. The neuroradiology journal, 19(5), 621-628.
4. Lee, J. W., Lee, I. S., Choi, K. U., Lee, Y. H., Yi, J. H., Song, J. W., ... & Kim, H. J. (2010). CT and MRI findings of calcified spinal meningiomas: correlation with pathological findings. Skeletal radiology, 39(4), 345-352.
5. Batnitzky S., Powers J. M., Schechter M. M. (1974). Falx "calcification" - does this exist?. Neuroradiology, 7(5), 255-260.
6. Halstead A. E., Christopher, F. (1923). Calcification and ossification of the meninges. Archives of Surgery, 6(3), 847-857.
7. Tubbs, R. S., Kelly, D. R., Lott, R., Salter, E. G., & Oakes, W. J. (2006). Complete ossification of the human falx cerebri. Clinical Anatomy, 19(2), 147-150.
8. Debnath J., Satija L., George R. A. et al. (2009). Computed tomographic demonstration of unusual ossification of the falx cerebri: a case report. Surgical and radiologic anatomy, 31(3), 211.
9. Al-Motabagani M., Haroun H., Meguid E. A. (2004). Calcification and ossification of the convexity of the falx cerebri and related subdural space in human cadavers. Neurosciences (Riyadh, Saudi Arabia), 9(4), 261-264.
10. Rao S. R., Rao T. R., Ovchinnikov N. et al. (2007). Unusual isolated ossification of falx cerebri: a case report. Neuroanatomy, 6, 54-55.
11. Usmani S., Marafi F., Al Kandari F. et al (2019). Normal Variant 18F-Sodium Fluoride Uptake in the Falx Cerebri Ossification. Clinical nuclear medicine, 44(10), 804-805.

Figure legends

Figure 1. Ossification of anterior part of falx (CT scan)