Historical vignette

A historical case of beaten-copper cranium

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The authors present the oldest historical case of a so-called beaten-copper cranium. The typical pattern was identified on a skull from a child, probably a boy, who died at approximately 6 years of age and was buried in a provisional cemetery used during the siege of Hanau, Germany, in 1635 and 1636. Morphological and radiological analyses of the severe digitate impressions ubiquitous on the child’s endocranium support the diagnosis of chronically elevated intracranial pressure due to hydrocephalus.

KEY WORDS • hydrocephalus • intracranial pressure • tumor • pediatric neurosurgery

MEDICINE has an important historical dimension apart from its clinical application, with disease reaching far back into the history of humankind. Human skeletal remains are essential biological source material, especially for historical epochs for which written documents do not exist. They provide useful information about alterations in disease frequency and pattern and are very helpful in answering questions regarding the living conditions and the quality of life of our ancestors. There is no doubt that each paleopathological bone lesion reflects human health and environments of the past. Moreover, the knowledge of the pathology and epidemiology of diseases throughout human history contributes to the crucial understanding of modern disease.1 Unfortunately, in ancient human remains, an unambiguous differentiation between intra vitam, peri mortem, and post mortem causes—especially in skull lesions—is often difficult to achieve.2 In the present example, however, there was no such difficulty. We describe a unique historical case of a severe intra vitam skull condition in a young child, a so-called “beaten-copper cranium.” The background of the case is also unusual, involving a well-known historical situation of a city under siege.

On May 23, 1618, a 30-year European war between Catholics and Protestants began with the Prague Rebellion. It was triggered by attempts by members of the royal houses to assure their ascendancy. During this war, in 1635 and 1636, the city of Hanau in central Germany was under siege for 9 months. The blockade of the city resulted in a large number of casualties, possibly due to lack of food as well as disease. The dead bodies could not be buried as usual—in graveyards outside of the city—but were placed, adults and children alike, in provisional burial grounds next to the inner city wall. All of the 41 excavated burials showed a high burden of pathological conditions. More than half of the skeletons were those of children younger than 12 years of age. All the remains of children showed prominent signs of developmental retardation (retarded synostosis of long bones, late tooth eruption, low stature). This exceptional burial ground allows the unique opportunity to assess the impact of chronic famine on the human skeletal system.

The skull remnants of one child who died at 5 to 7 years of age and was probably a boy (Grave 40, a complete but fragmented skeleton; age and sex determination according to established anthropological methods) have been investigated morphologically, by conventional radiography and CT. An endocranial cast of the reassembled skull was also produced. Deep digitate impressions are visible everywhere on the endocranium, though they are especially prominent on the basal part of the frontal region (Fig. 1 left). The negative cast of the endocranium (Fig. 1 right) highlights the impresive gyrilike surface, especially at the most basal part of the cranium. Conventional radiographs reveal the focal thinning—digitate impressions—of the skull (Fig. 2 left). Computed tomography scans show that the internal and external tables of the calvaria are unaltered, but reveal local-

Abbreviation used in this paper: CT = computed tomography.
ized thinning of the diploë, which may represent negative impressions of adjacent gyri (Fig. 2 right). All of these findings are consistent with the diagnosis of an intra vitam diffuse beaten-copper cranium.

The severe extensive beaten-copper appearance of this historical skull most likely represents the mechanical manifestation of chronically elevated intracranial pressure. Theoretically, the diffuse pattern of this particular cranium may also reflect a normal variant, although this explanation is much less likely than it would be if the beaten-copper appearance were in the posterior skull only. Markings of this type are referred to as “convolutional” markings, corresponding to the cerebral convolutions. However, in recent studies, the overall severity of the beaten-copper pattern has statistically been found to be significantly lower in controls than in individuals affected by craniofacial syndromes.

According to established radiological classifications, the present historical case would receive a maximum severity grade, based on the severity of the lesions and their extent (more than 50% of each skull compartment affected).

Due to the lack of any notable cranial deformity, the most probable cause of the present “cloudy skull” or beaten-copper skull would be hydrocephalus. A pre- or perinatal onset of hydrocephalus—as in cases of meningomyelocele—seems rather unlikely. An onset later in life does not necessarily result in obvious cranial distortions and is therefore more probable in the present case. Another possibility, premature craniosynostosis as in Crouzon-syndrome, can be excluded because the preserved cranial sutures show no abnormalities. Other rare conditions, such as tumors, postinfectious states (for instance, tuberculosis meningitis), and cystic lesions, would have to be considered in a differential diagnosis.

The lack of historically available adequate surgical treatment—that is, extensive craniotomy—may have caused short- and long-term nonspecific symptoms such as headaches and psychomotor retardation, respectively, in this individual. Whether the premature death of this child occurred as a direct or indirect complication of this condition remains a mystery, but it is likely.
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Paleopathology is the science of disease found in human and animal remains, which enables us to understand the nature, causes, and frequency of diseases of past populations. A well-documented, unique historical case such as the one presented here helps to increase our knowledge of the past and to gain medicocultural insights.

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