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MORPHOMETRICAL STUDIES OF POSTERIOR FONTANEL IN DIFFERENT PERIODS OF FOETAL LIFE

MORFOMETRYCZNE BADANIA CIEMIĄCZKA TYLNEGO W RÓŻNYCH OKRESACH ŻYCIA PŁODOWEGO

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Streszczenie

Wstęp: W czaszce noworodka występuje 6 ciemiączek. Wcześniej prace badawcze dotyczyły głównie rozwoju ciemiączka przedniego u płodu i u noworodka. Obecne badania mają na celu odpowiedzenie na pytanie, jak wygląda rozwój ciemiączka tylnego w różnych okresach życia płodowego.

Materiał i metody: Badania przeprowadzono na 71 płodach ludzkich w wieku 15–29 Hbd utrwalonych standardowymi metodami w 10% formalinie. Zmierzono długość, szerokość ciemiączka tylne oraz długość, szerokość i obwód głowy. Dokonano obliczeń statystycznych.

Wyniki: Długość i szerokość ciemiączka tylne wzrasta do 25 Hbd, a następnie zmniejsza się.

Wnioski: Na podstawie oceny rozwoju ciemiączka tylnego można oszacować prawidłowości rozwoju płodu oraz wykrywać patologie rozwojowe, m.in. zaburzenia metaboliczne tkanki kostnej.


Summary

Purpose: There are 6 fontanels in the newborn's skull. Scientists have been mainly interested in the development of anterior fontanel in foetus and newborn. There are no researches about the development of posterior fontanel. The aim of our study was to estimate the size of posterior fontanel in different periods of foetal life.

Material and methods: The study was carried out 71 human foetuses of age 15–29 Hbd, which were preserved in 10% formalin. The width and length of posterior fontanel and the length, width and circumference of foetuses’ heads were measured. All data were analysed statistically.

Results: The width and length of posterior fontanel increases up to 25 Hbd, and it decreases afterwards. The ratio of posterior fontanel's length to the length of foetus’ head shows the increase in the group of foetuses up to 25 Hbd, but the decrease in group of foetuses from 25–29 Hbd.

Conclusions: The analysis of posterior fontanel progress from single to complex stage may be used to form an opinion about normal or pathological development of human fetus’s body such as metabolic disorder’s of bone tissue.

Keywords: posterior fontanel – foetal life – intrauterine period.

Introduction

Before birth and during infancy period the bones of skull are separated from each other by membranous intervals. These intervals are principally found at the four angles of the parietal bones. They are called fontanels and there are 6 of them. Two are paired: sphenoid and mastoid fontanels, another two are uneven: anterior and posterior fontanel. Scientists have been interested in anterior fontanel for a long
time [1, 2, 3, 4, 5, 6]. Therefore, there are many publications about its development and size in foetuses and infants. The posterior fontanel is smaller in size and triangular in shape. It is situated at the junction of the sagittal and lambdoid sutures. Its top is positioned anteriorly.

Posterior part of the skull reaches 65% of its size during the growth in the womb [6, 7, 8, 9]. An intensive growth of the neurocranium is caused by the rapid development of brain and relatively slow process of the ossification. It raises the question: do rapid development of brain and relatively slow process of the ossification have any impact on the size of posterior fontanel?

The aim of our study was to estimate size of posterior fontanel in different periods of foetal life.

**Material and methods**

The study was carried out on 71 human foetuses, which were selected from collection of the Anatomy Department of Pomeranian Medical University in Szczecin. Foetuses were preserved in 10% formalin and divided into 3 groups according to the foetal age, calculated on the measurement of CRL and their total length established according to Scammon and Calkins methods.

- I group 15–19 Hbd – 23 foetuses,
- II group 20–24 Hbd – 24 foetuses,

On the head’s skin, three corners of posterior fontanel were marked as points A, B and C. Afterwards they were transferred on the foil and paper. Then the point D was marked in the middle of line BC. This line formed the width of posterior fontanel, whilst line AD its length (both expressed in millimetres) – figure 1. The width and length of posterior fontanel were measured. Additionally head’s length, width and circumference were measured.

**Results**

1. The measurement of posterior fontanel’s length and width proved to be longer in the II group than in the I group (tab. 1).

2. The average length and width of posterior fontanel proved to be smaller in the III group than in the II group.

3. The ratio of posterior fontanel’s length to the length of foetus head shows the increases in II group in relation to I group, but the decrease in III group in relation to II group (tab. 2).

4. The proportion of head’s width to posterior fontanel’s width increases throughout all groups.

**Discussion**

Clinical examination of the fontanels is used to search for evidence of increasing intracranial pressure and index of skull’s ossification. Therefore, fontanel’s sizes are a clue
helping to diagnose a number of disorders in which skeletal morphogenesis is abnormal (e.g., congenital hypothyroidism, achondroplasia, osteogenesis imperfecta and other conditions – including progeria) [10]. The abnormality of size and shape of posterior or anterior fontanel can be found side by side with genetics disorders such as: human triploidy, duplication of 7p, trisomy 7p and 6p, Potocki–Shaffer syndrome, diaphragmatic hernia-exomphalos-hypertelorism syndrome, Melnick–Needles syndrome and Haar syndrome [11, 12, 13, 14, 15, 16, 17, 18]. A number of factors are known to influence fontanel’s sizes, namely: brain growth, dural attachments, suture developments and osteogenesis [19]. Surprisingly, there are few studies in the literature of the variation of fontanel’s sizes with gestational age. Davìes et al. [20] with his team studied such a relation. They reported enlargement of the anterior fontanel with increasing gestational age among normal neonates. Other scientists studying the subject have found no evidence of difference in sizes of closure of anterior fontanel among twins and prematurely born babies [21]. In our study we have noticed that length and width of posterior fontanel increased during second term of pregnancy. It is consistent with results obtained by Ziółkowski and Kurlej [22]. Their study was conducted on 217 foetuses aged 4 to 7 months. They had found that length and width of posterior fontanel change periodically with foetal life. Moreover, width and relative height of the neurocranium decrease in relation to its length in the early stage of foetal life. Similar relations were proved by our study.

Trenouth [23] found the biggest relative increase in antero-posterior dimension of skull correlates with age. They found the relative increase of skull’s width, however, it was smaller than the increase in antero-posterior dimension. Dimensions measured by us have shown positive correlation between skull’s width and width of posterior fontanel. The increase of skull’s length shows no linear correlation with length of posterior fontanel. During the foetal period, the biggest convexity of the cranium is located in the frontal squama, however, it gradually diminishes with age [22]. The nuchal part of the occipital squama increases in relation to the occipital part [7, 22]. It may be a reason causing slow growth rate within length of posterior fontanel.

Anterior, posterior and sphenoid fontanel has membrane structure, while cartilage layer covers the mastoid one. This is a remainder of skull structure’s membrane origin. It is known, that lateral and upper parts of the skull are formed on the membrane basis. Ossification process starts in certain lines (strain lines). There are two ossification points, upper and lower of the crown of the head. They appear usually in the 8th week of pregnancy. Osseous beans radiate from there, but afterwards they join. Ossification process reaches the climax around 24th week of pregnancy. Moreover, the process of brain’s growth speeds and reaches its maximum at 28th week of foetal live [24]. These changes lead to the increase of head’s length and width. However, at the same time, posterior fontanel shrinks. The head can increase its size owing to membrane tissue, which amount decreases and is replaced by the osseous one. That results in systematical reoccurring decrease dimension of length and width of posterior fontanel. At the beginning of the pregnancy, these two dimensions increase but in the second trimester, they decrease constantly.

Anterior fontanel is usually used in the sonographic examinations of structures of neonatal brain [4, 5]. New review describes the examination technique used to study the neonatal brain via the mastoid fontanel and offers a panoramic view of the anatomical structures that can be identified in each US slice [25]. The ultrasound examination by the posterior fontanel can offer a new view on the brain’s structures.

Conclusions

1. Length and width of posterior fontanel change gradually according to foetal age.
2. Length and width of foetus’s head increase with non-proportional, slower growth rate.
3. The analysis of the posterior fontanel status may be used as a part of estimation process of normal foetus development and a way to discover pathologic disorders e.g. genetic or metabolic ones.

References


