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Typical changes of ethmocephaly and holoprosencephaly in a fetus at 14 weeks of gestation

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Abstract:

Background: This case report is to show the details of the face of a very rare ethmocephaly at 14 weeks of gestation.

Case presentation: After the regular transabdominal two-dimensional (2D) scan for nuchal translucency we could describe the following malformations: holoprosencephaly, proboscis and an abnormal face, omphalocele containing bowel, hyperechoic kidneys and megacystis. In addition, we acquired transvaginal three-dimensional (3D) ultrasound volume blocks of the fetal head, scanned with different insonation angles and stored them for later analysis. Using the multiplanar mode the volume blocks taken from the front show all details of the face: proboscis, hypotelorism, microphthalmia, cleft palate, accelerated development of the frontal bones and premature closure of the metopic suture. The volume blocks taken through the squamosal suture show all details of the fossa posterior and brain: fused thalami surrounded by the typical monoventricle, normal brain stem, elongation of anterior membranous area. Render mode shows a precise 3D image of the face. To better demonstrate the changes of the fetal face a post-mortem photo of the fetal face is included.

Conclusion: This case report can demonstrate the typical changes of ethmocephaly in the first trimester using transvaginal 3D scan.

Keywords: Ethmocephaly, fetal brain, fetal face, fossa posterior, holoprosencephaly, proboscis, transvaginal 3D sonography

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Introduction

Holoprosencephaly is a severe cerebral malformation showing disturbance of the sagittal cleavage of the embryonic prosencephalon into hemispheres, the transversal cleavage into telencephalon and diencephalon and the horizontal cleavage into olfactory and optic bulbs [1], [2]. The malformation typically occurs in the 5th and 6th gestational week. Ethmocephaly lies in the midst of the holoprosencephalic spectrum, classically manifesting with hypoteloric eyes, separate orbits and interorbital proboscis [3], [4]. The spectrum encompasses normocephaly, mild facial dysmorphism, median cleft lip, cebocephaly, ethmocephaly and cyclopia [5], [6]. The holoprosencephalic spectrum shows the correlation between the extent of brain changes and the extent of facial dysmorphism. Pronounced forms of holoprosencephaly are associated with characteristic mid-face anomalies in 70–80% of cases, in contrast to mild forms where the deviation from the normal anatomy of the face is marginally.

Case presentation

A 22-year-old gravida 2, para 1 was referred to our unit for a detailed 1st trimester scan at crown-rump-length of 84 mm presenting with adverse ultrasound findings. Using the two-dimensional (2D) scan, we found a typical

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alobar holoprosencephaly, exomphalos containing bowel (10.5×10.6 mm), megacystis [2], [7] (bladder length 15.7 mm) and a nuchal translucency of 4.8 mm. The fetal heart rate was 153 bpm. The face transabdominally showed a strange appearance with a protruding mouth and a flat nose and forehead [8]. For a better sight we changed to transvaginal ultrasound including three-dimensional (3D) samples in addition. Transvaginal 3D ultrasound showed the following additional findings: large hyperechoic kidneys (right: 8.78×7.97×14.8 mm, left: 7.48×6.43×14.0), ethmocephaly including proboscis, hypotelorism, microphthalmia, cleft palate and hypoplasia of the vermis. After informing the parents about the fetal malformations, the woman asked for the termination of the pregnancy, refusing the search for a genetic syndrome and refusing the autopsy. Described in the following are the details of the 3D scan of the fetal face and brain we found.

Face sagittal (Figure 1–Figure 3)

In the mid sagittal plane, the proboscis is the most notable structure, appearing as a nasal appendage, typically arising from the ethmoid bone, turning upward and opening with a single nostril [1], [9] (Figure 1). Directly under the ethmoid bone, the aperture of the eyelid is situated in the midline, caudally the face is flat, the nose is absent. Using a different insonation angel maxillary gap measuring 2.7 mm (normal <1.5 mm) and palatino-maxillary diameter (Figure 3) measuring 1.2 mm (<5th centile) as a marker of cleft palate are displayed [10], [11].

Figure 1: Median sagittal: arrowhead, absent nose; asterisk, lid opening; arrow, Ve, vermis; Pr, proboscis.

Figure 2: Axial, paramedian sagittal: Ch, choanal atresia; arrow, lid opening; arrowhead, absent nose; HPE, holoprosencephaly; CeH, hemisphere of the cerebellum.

Figure 3: Axial, median sagittal: arrow, maxillary bone without suture; arrowhead, MG maxillary gap, PMD, palatino-maxillary diameter.

Face axial (Figure 2–Figure 5)

The axial plane with the ethmoid bone in the middle shows microphthalmia [ocular diameter (OD) 2.8/3.0 mm] on both sides of the ethmoid bone, close to the ethmoid bone and close to each other [interocular distance (IOD) 5,8 mm] (hypotelorism) [12], [13], [14], [15], [16], [17] (Figure 4). The plane underneath the eyes and the proboscis presents with the aperture of the eyelid in the middle. Caudally to this plane the facial skeleton presents with two approximately round structures close to the midline, representing choanal atresia (Figure 2), resulting from the coalescence of the pterygoid plate and palatine bones. The processus alveolares maxillae form a thickened plate as a result of disturbed development of the maxillary suture [18].

Figure 4: Axial: arrowhead, eyes (microphthalmia, hypotelorism); Eth, ethmoid bone; DiE, diencephalon; PC, pedunculi cerebri; arrow, transverse cerebellar diameter.

Figure 5: Axial: arrowhead, proboscis; DiE, diencephalon; HPE, holoprosencephaly; arrow, cerebellum; asterisk, metopic suture.

Face coronal (Figure 6)

Selecting a coronal section of the fetal head the height of the frontal bone [11 mm (4.5–8 mm)] and the transvers gap of the metopic suture [0.6 mm (1–2 mm)] are visible [19] (Figure 6). Accelerated development of the frontal bones and premature closure of the metopic suture are typical changes associated with alobar holoprosencephaly.

Figure 6: Coronal: O, orbita; 1, height of the frontal bone; 2, distance of the metopic suture.

CNS axial (Figure 4 and Figure 5)

Using axial planes the alobar holoprosencephaly can be seen showing the fused thalami surrounded by the typical monoventricle. The absence of the falx cerebri can be displayed as well as a typical sign of holoprosencephaly. Transverse cerebellar diameter (TCD) of the cerebellum (13 mm) is within the normal range (Figure 4).

CNS sagittal (Figure 1)

The median sagittal plane shows the monoventricle cranially to the thalami. The structures of the fossa posterior show a small vermis (3.2 mm – at the 5th percentile), whenever the brain stem shows a normal appearance: pons diameter 2.7 mm, diameter of medulla oblongata 2.6 mm, medulla oblongata angle 139°. The anterior membranous area was 0 mm, posterior membranous area showed 5 mm >95th percentile [20].

Discussion

This case report presents the typical details of a very rare case of ethmocephaly (0.06%) as part of the holoprosencephalic spectrum. Ethmocephaly is a well-defined malformation of the face including hypoteloric eyes, separate orbits and interorbital proboscis. It is typically associated with alobar holoprosencephaly.

This case report can demonstrate, that it is possible to display all details of the fetal face and brain very early in pregnancy, when doing 1st trimester screening. Therefore, it is useful to add a transvaginal 3D volume scan to the transabdominal 2D scan, usually done in this week for nuchal translucency and 1st trimester screening. As we already could demonstrate in our publication about the sonoembryology of the fossa posterior [20], [21], it is useful to do the 3D scan for details of the fossa posterior. In this case report we additionally show that the face can also be displayed in great detail, when using transvaginal 3D scan from a frontal insonation angle.

The mid sagittal view of the face shows the typical reduced ossified area of cleft palate [22], presenting with both recently published signs: the enlargement of maxillary gap and the shortening of palatino-maxillary diameter [10], [11]. Anterior to the cleft palate the processus alveolares maxillae present thickened and buckled [18].

In addition, accelerated development of the frontal bones and premature closure of the metopic suture as a typical sign of holoprosencephaly can be demonstrated [19]. Measurement of interlens and interorbital/biorbital distance can demonstrate hypotelorism, measurement of the orbit (distance) and lens (diameter, circumference, area) demonstrate microphthalmia.

Holoprosencephaly has been an easily displayable detail of the fetal brain scanned transabdominally with 2D technique, even in earlier weeks of gestation, it is now possible to scan more details of the fetal brain using transvaginal 3D volume blocks. Especially as demonstrated in earlier publications details of the fossa posterior can be shown. In this case the vermis is at the 5th percentile, the brainstem (diameter of medulla oblongata/pons and medulla oblongata pons angle) shows normal values, the anterior membranous area is 0 mm, as part of the normal development. In contrast the posterior membranous area shows abnormal elongation (>95th percentile) [20], [21].

In order to visualize the fetal face, it is possible to use the stored 3D blocks to create a three-dimensional picture (Figure 7) by using render mode showing the same changes as the post-mortem photo (Figure 8).

Figure 7: Render: Pr, proboscis; arrowhead, lid opening; asterisk, absent nose; ring, upper lip.

Figure 8: Photo: Pr, proboscis; arrowhead, lid opening; asterisk, absent nose; ring, upper lip.

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