HDlive Studio and HDlive Silhouette Mode for Antenatal Diagnosis of Apert Syndrome

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ABSTRACT

We present our first experience of using HDlive Studio and HDlive silhouette mode to diagnose Apert syndrome. A 31-year-old pregnant Japanese woman was referred to our hospital due to suspected skull bone abnormalities at 20 weeks and 1 day of gestation. Two-dimensional (2D) sonography showed clover leaf-like skull. HDlive Studio clearly depicted brachycephaly. An X-ray mode demonstrated broad metopic and sagittal sutures, and large anterior and posterior fontanels. HDlive silhouette mode clearly showed closures of bilateral coronal sutures. HDlive Studio also depicted fused fingers and toes. Diagnosis of Apert syndrome was highly suggested. She was delivered vaginally of a viable female fetus at 41 weeks and 4 days of gestation. Her birth weight was 3,836 g with an Apgar score of 7 (1 minutes) and 9 (5 minutes), and the umbilical artery pH was 7.208. Craniosynostosis and syndactyly of fingers and toes were noted. Postnatal examination confirmed the diagnosis of Apert syndrome. HDlive Studio can be a useful adjunctive diagnostic tool to confirm fetal congenital anomalies due to realistic, comprehensive images.

Keywords: 3D ultrasound, Antenatal diagnosis, Apert syndrome, Fetus, HDlive Studio, HDlive silhouette mode.

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INTRODUCTION

Apert syndrome is a rare autosomal dominant disorder with an estimated incidence of 1 per 65,000 live births.¹ It is characterized by craniosynostosis, which restricts the growth of the skull resulting in craniofacial abnormalities. Midfacial hypoplasia, symmetric cutaneous, and bony syndactyly of the limbs are the other characteristics of this syndrome.² Diagnosis is usually suggested by prenatal sonography^{3,4} and confirmed by prenatal fibroblast growth factor receptor type 2 (FGFR2) mutation analysis.⁵ Numerous reports discussed the antenatal diagnosis of Apert syndrome using two-dimensional (2D) and three-dimensional (3D) ultrasound as well as magnetic resonance imaging (MRI).^{3,4,6-13} However, to the best of our knowledge, this is the first report assessing the use of HDlive silhouette mode and HDlive Studio in antenatal diagnosis of Apert syndrome.

CASE REPORT

A 31-year-old pregnant nulliparous Japanese woman was referred to our hospital due to suspected skull bone abnormalities at 20 weeks and 1 day of gestation. 2D sonography showed a trilobate shape of the skull (Fig. 1A). HDlive Studio (Voluson E10,

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GE Healthcare Japan, Tokyo, Japan) clearly showed brachycephaly (Fig. 1B). The 3D maximum mode showed broad metopic and sagittal sutures, and large anterior and posterior fontanels (Fig. 2).

Figs 1A and B: Fetal skull at 20 weeks and 1 day of gestation showing trilobate appearance (A). HDlive Studio clearly shows brachycephaly (B)

Figs 2A and B: Fetal skull at 20 weeks and 1 day of gestation demonstrated by the 3D maximum mode, showing broad metopic and sagittal sutures, and large anterior and posterior fontanels in frontal (A) and posterior (B) views

Figs 3A and B: Fetal skull at 23 weeks and 1 day of gestation demonstrated by HDlive silhouette mode, confirming the widened fontanels and metopic suture in superior view (A), in addition to closure of the coronal suture demonstrated in lateral view (B). R, right; L, left

Figs 4A and B: Conventional 3D ultrasound images of fetal extremities at 27 weeks and 1 day of gestation. Fusion of fingers and toes can be seen in the right hand (RH) and foot (RF) (A), as well as the left hand (LH), and foot (LF) (B)

At 23 weeks and 1 day of gestation, HDlive silhouette mode confirmed the widened fontanels and sutures, and early closure of bilateral coronal sutures (Fig. 3). Conventional 3D images of the fetal limbs showed abnormalities of the fingers and toes at 27 weeks and 1 day of gestation (Fig. 4). HDlive Studio and HDlive silhouette mode clearly demonstrated the limb abnormalities in the form of fusion of the digits of fingers and toes at 28 weeks and 1 day (Fig. 5). Diagnosis of Apert syndrome was highly suggested.

At 41 weeks and 4 days of gestation, she was delivered vaginally of a viable female infant weighing 3,836 g, and the height was 52.5 cm. Apgar score was 7 (1 minute) and 9 (5 minutes), and the umbilical artery blood pH was 7.208. Postnatal examination confirmed brachycephaly and syndactyly of fingers and toes (Fig. 6). 3D CT showed the widened metopic suture and fontanels, and bilateral coronal sutures were closed (Fig. 7). Genetic study confirmed the presence of FGFR2 mutation (Fig. 8). Final diagnosis was Apert syndrome.

DISCUSSION

The cloverleaf-like appearance of the skull resulting from craniosynostosis in addition to the syndactyly is usually suggestive of diagnosis in cases of Apert syndrome.³ However, the appearance of these differential features can be as early as 16 weeks of gestation,¹⁰ or delayed up to 32 weeks of gestation.¹⁴ Moreover, the craniosynostosis was not present in some cases.¹⁵ On the contrary, craniosynostosis is shared by other anomalies such as thanatophoric dysplasia, severe Crouzon syndrome, and Carpenter syndrome.¹⁶ Syndactyly can be easily identified especially the complex type involving bony fusion.¹⁷ However, the use of the 3D ultrasound in identifying the soft type of syndactyly becomes mandatory because it cannot be detected by conventional 2D sonography.¹⁶ Therefore, meticulous sonographic examination might be needed to detect these anomalies.

Figs 5A to D: HDlive Studio and HDlive silhouette mode images of fetal right hand (A and B), and foot (C and D) clearly, demonstrating the fusion of the fingers and toes at 28 weeks and 1 day of gestation. HDlive silhouette mode (B and D) shows more precise features of the fusions of fingers and toes

Figs 6A to D: Postnatal pictures of the neonate. Brachycephaly (A) and syndactyly of fingers (B) and toes (C and D) can be noted

Fig. 7: 3D CT images of the skull of the newborn baby, showing the widened fontanels and metopic suture as well as fused coronal sutures

The use of 3D ultrasound has been previously described in cases of Apert syndrome.^{8,12,18–20} In these studies, 3D ultrasound with the transparent maximum mode was found to be beneficial in demonstrating the closure of the coronal suture and widening of the metopic suture more clearly compared with conventional 2D sonography.^{8,12,18,19} HDlive silhouette mode is one of the novel technologies to evaluate fetal bony structures.^{21,22} In the current case, the HDlive silhouette mode clearly depicted the early closure of the coronal suture. To the best of our knowledge, this is the first study to evaluate fetal cranial sutures using the HDlive silhouette mode. Moreover, the HDlive silhouette mode enabled more clear recognition of the precise fusions of fingers and toes in comparison to conventional 3D ultrasound features. Limb anomalies are usually hard to be detected because of inappropriate limb positions or

Fig. 8: A mutation in the FGFR2 gene. Upper, control; lower, patient

fetal movements, which make their identification difficult when only conventional 3D ultrasound is used.

In conclusion, HDlive Studio and HDlive silhouette mode may be a beneficial adjunct diagnostic tool beside the conventional 2D and 3D ultrasound for the precise diagnosis of Apert syndrome. Further studies are needed to confirm the true benefits of these technologies in the diagnosis of fetal craniosynostosis syndromes.

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