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NOTE

Virtual bronchoscopy through the fetal airways in a case of cervical teratoma using magnetic resonance imaging data

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Cervical teratomas are rare congenital tumors, usually solid or cystic (3–5% of all teratomas), with an incidence of 1:20 000 to 1:40 000 among live births (Nascimento et al. 2007). This malformation is usually diagnosed during the prenatal period by ultrasound exam in the second and third trimesters. Knowledge about the degree of compression of the fetal airways during the prenatal period is important for the obstetrician/neonatology team to plan the correct management strategy during delivery (Azizkhan et al. 1995).

A 28-year-old primiparous pregnant woman was referred to our service with a diagnosis of fetal neck mass at 21 weeks during the second trimester ultrasound exam. Another ultrasound exam showed a large solid/cystic mass measuring 41 × 24 mm in the fetal cervical region, and no other fetal abnormalities were observed. Subsequent follow-up ultrasound exams showed a normal amniotic fluid index. We decided to perform a three-dimensional ultrasound (3DUS) and magnetic resonance imaging (MRI) at 36 weeks for a better assessment of the fetal airways to plan the delivery (Fig. S1). The ultrasound exam was performed using a Voluson E8 apparatus (General Electric Medical System, Zipf, Austria) equipped with a convex probe (RAB 4-8L). The 3D images were shown on the screen in multiplanar (three orthogonal planes–axial, sagittal, and coronal) and rendering modes. The MRI exam was performed using a 1.5-T scanner (Siemens, Erlangen, Germany). The protocol involved a T2-weighted sequence in the three planes of the fetal body (HASTE; repetition time (TR), shortest; echo time (TE), 140 ms; field of view, 300–200 mm; matrix, 256 × 256; slice thickness, 4 mm; acquisition time, 17 s; 40 slices). In addition, we applied 3D T2-weighted true fast imaging with a steady-state precession (true fisp) sequence in the sagittal plane (TR, 3.02 ms; TE, 1.34 ms; voxel size, $1.6 \times 1.6 \times 1.6$ mm^3; FA, 70; PAT, 2; acquisition time, 0.26 s). The entire examination time did not exceed 30 min (Fig. S2).

A 3D physical model of the fetal airways was generated using the overlapping image layers generated by the MRI, using the software Mimics (Materialise, Leuven, Belgium), which allowed delineation of the airway surface using contrast detection in the relevant areas of interest. The generated 3D model was exported using the standard triangular language file format and then converted into an OBJ file using the MAYA 3D modeling software (Autodesk, San Rafael, CA, USA). The software allowed the correct virtual positioning of the observation cameras, while working with multiple onscreen windows, and the lighting parameters could also be adjusted to optimize the visualization. Finally, a path was plotted through the 3D model to create a simulated movie for the analysis of the fetal airway (Fig. 1). A virtual navigation through the fetal airways allows the visualization of the upper respiratory tract from the pharynx downward through the tracheobronchial tree. In our case, the virtual bronchoscopy did not identify the compression of the fetal airways (Video clip). A cesarean section was planned at 37 weeks, through which the woman gave birth to a live female baby weighing 3.175 g, with a height of 49.5 cm, and Apgar scores of 8 and 9 at the 1st and 5th min, respectively. After 48 h of delivery, the neck mass was surgically removed, without the need for endotracheal intubation. Both the mother and child were discharged from the hospital on the 7th day after delivery.

Virtual bronchoscopy is a new, noninvasive technique that allows the assessment of patency of the fetal airways (Werner et al. 2011). The efficacy of this technique in assessing the fetal airway patency has been proven in four fetuses with cervical teratomas (Werner et al. 2013). In our case report, the virtual bronchoscopy confirmed the fetal airway patency and allowed an adequate management of the delivery by the obstetrician/neonatology team, without the necessity of invasive procedures such as ex utero intrapartum treatment (EXIT).

In summary, we reported a case of fetal cervical teratoma with a favorable postnatal outcome using virtual navigation through the fetal airways. We believe that virtual bronchoscopy may be an effective method to assess the fetal airway patency in cases of neck masses or other extrinsic compressive lesions of the upper respiratory tract.

DISCLOSURE

None.

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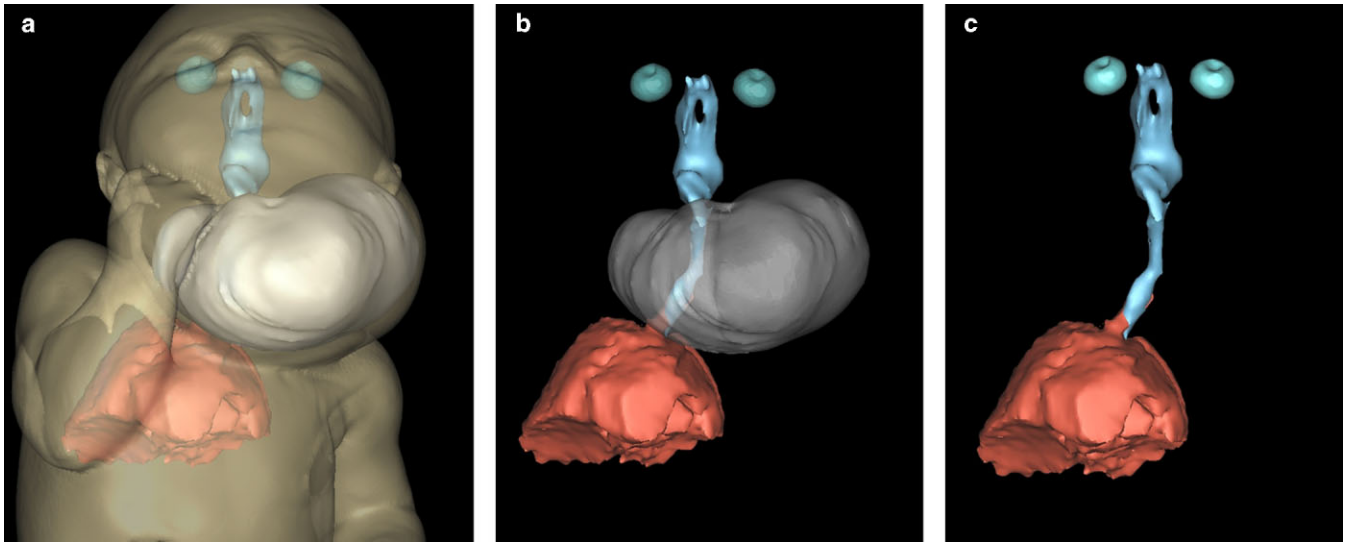

Fig. 1 Fetal cervical teratoma at 36 weeks of gestation. (a) 3D physical model showing the relationship between the fetal cervical teratoma and airways. (b) and (c) Virtual bronchoscopy showing the patency of fetal airways.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Fig S1. Fetal cervical teratoma at 36 weeks of gestation. (A) Three-dimensional ultrasound in the rendering mode showing the neck mass. (B) Magnetic resonance imaging in the sagittal view in T2-weighted sequence showing the solid/cyst neck mass.
Fig S2. Magnetic resonance imaging with three-dimensional reconstruction in a fetus with cervical teratoma at 36 weeks of gestation.
Video clip. The virtual camera may be observed entering the fetal airways and observing its patency.