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Picture of the Month

Virtual bronchoscopy in the fetus

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The term 'virtual bronchoscopy' describes the creation and evaluation of representations of the bronchial tree and surrounding structures using spatial information derived from imaging sources other than the bronchoscope itself. Initially, this referred to two-dimensional and later three-dimensional (3D) bronchial tree representations generated from computed tomography images. However, virtual bronchoscopy can now also be performed using data from magnetic resonance imaging (MRI). Several software options are available that can be used to generate accurate and realistic renderings of the bronchial tree[1–3].

Advances in imaging technology have led to vast improvements in fetal evaluation. Ultrasound examination is the primary method of fetal assessment because it is patient-friendly, effective, cost-efficient and considered to be safe[4]. MRI is generally used when ultrasound cannot provide sufficiently high-quality images. It offers high-resolution fetal imaging with excellent contrast that allows visualization of internal tissues[5]. In this article we describe virtual bronchoscopy performed in a normal fetus that underwent MRI at 28 weeks' gestation due to placenta previa with suspicion of placenta accreta.

MRI examination 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 a 3D, T2-weighted TrueFISP sequence in the sagittal plane (TRUFI; TR/TE = 3.02/1.34; voxel size $1.6 \times 1.6 \times 1.6\ mm^3$; flip angle = 70°; parallel acquisition techniques 2; acquisition time, 0.26 s) (Figure 1). The entire examination time did not exceed 20 min.

The 3D MRI datasets were reconstructed to produce an interactive surface model of the fetal respiratory tract that could be viewed from any angle. Firstly, a 3D model of the fetal airway was created from the overlapping image layers generated by MRI using the software Mimics (Materialise, Leuven, Belgium), which allowed the surface of the airway to be delineated using contrast detection in the relevant areas of interest. The 3D model that was generated 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)[6,7]. This program allows the virtual positioning of observation cameras while working with multiple on-screen windows. After the development of the 3D model, the software allows the user to determine the best positioned viewpoints for visualization of the 3D model (Figure 2) and also facilitates the adjustment of lighting parameters to improve contrast resolution. Using the navigation mode it is also possible to perform virtual bronchoscopy to visualize the upper respiratory tract from the pharynx downwards through the tracheobronchial tree (Videoclip S1) with a quality similar to that which could be obtained by videotaped bronchoscopy.

We have demonstrated that MRI data can be used to create a 3D model of the respiratory tract in a normal fetus. We believe that this technique could become a useful tool for the assessment of fetal airway patency.

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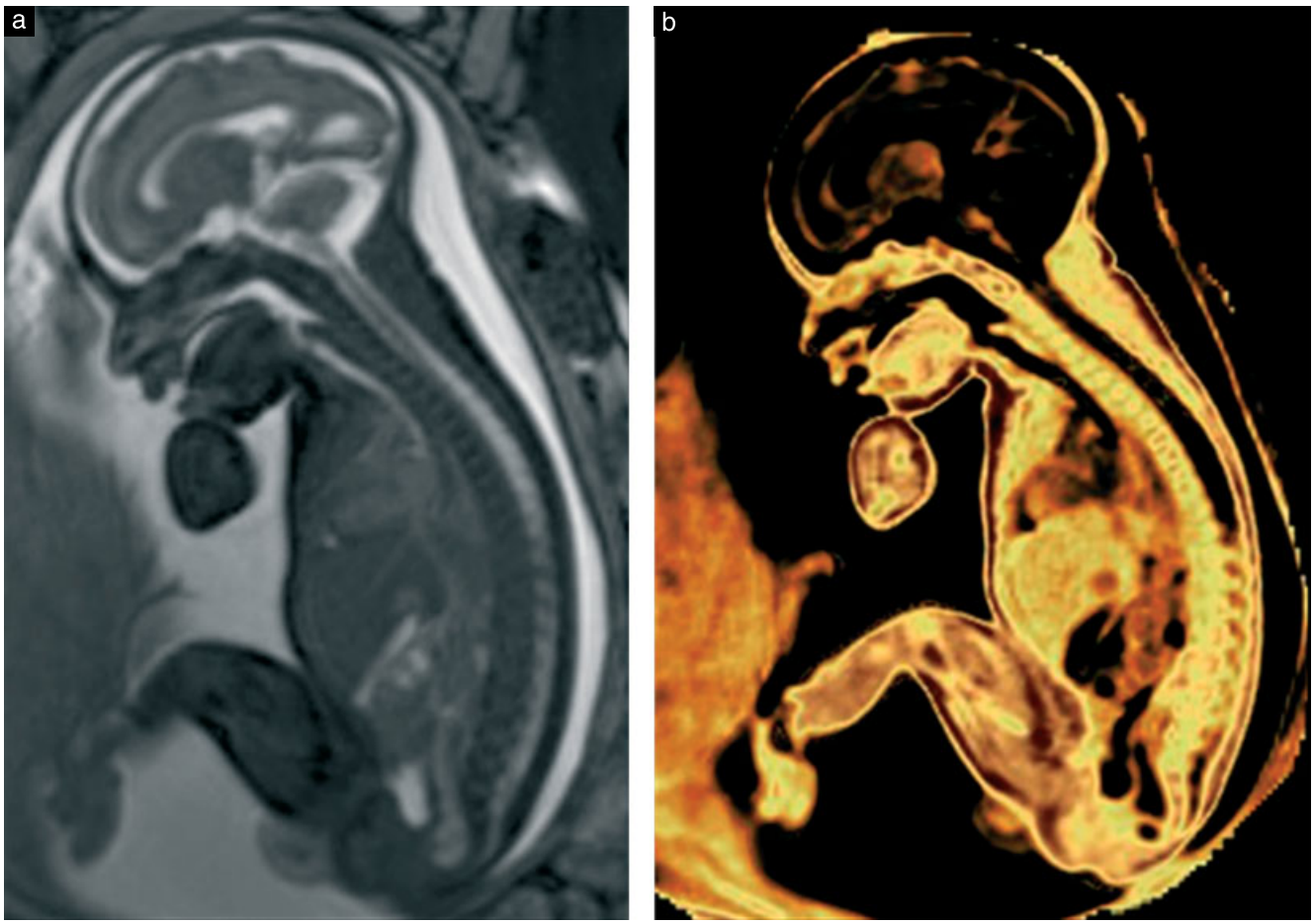

Figure 1 Magnetic resonance images of a fetus at 28 weeks' gestation. (a) T2-weighted TrueFISP sequence in the sagittal view showing the normal airway. (b) Postprocessed volume rendering technique image (slice thickness 1.8 mm) demonstrating the same view.

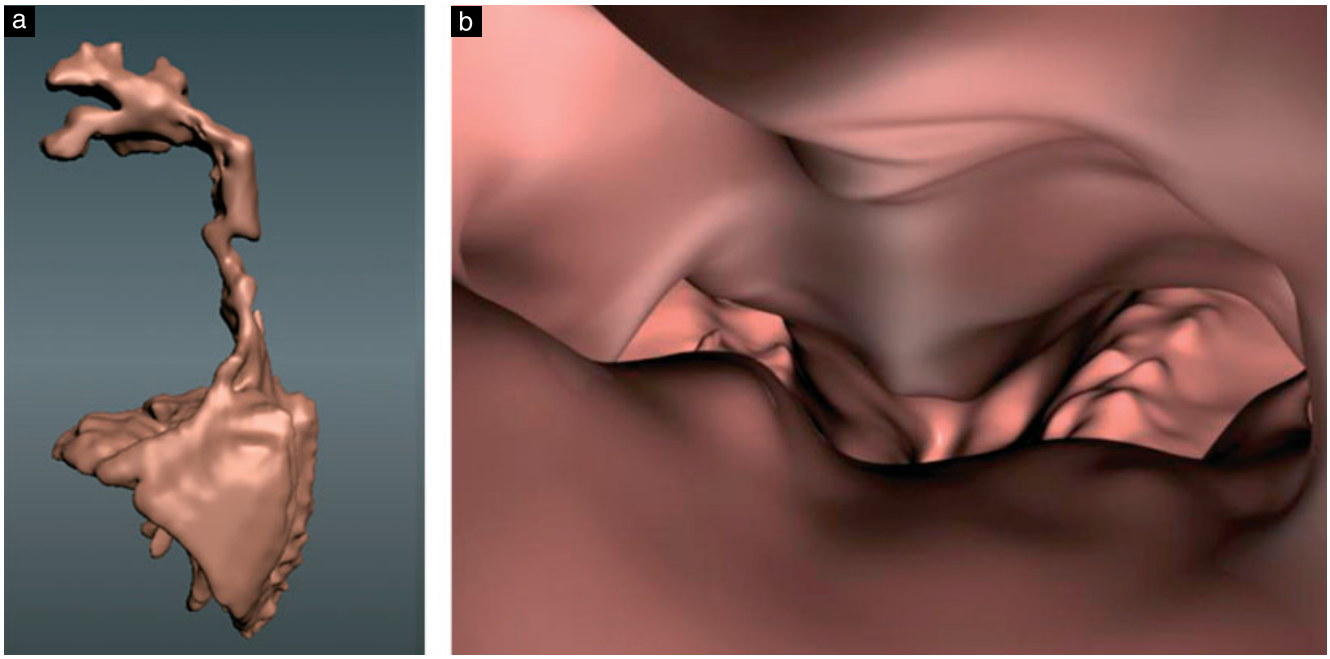

Figure 2 (a) Three-dimensional view of the lungs with airway paths (sagittal view) and (b) virtual bronchoscopic image of normal carina and mainstem bronchi.

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SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Videoclip S1 Virtual bronchoscopy to visualize the fetal upper respiratory tract from the pharynx downwards through the tracheobronchial tree using the navigation mode in the MAYA 3D modeling software.

