

View Abstract

CONTROL ID: 3597553

TITLE: Walk-through the fetal heart: simulation of *in utero* operation using virtual reality enhanced four-dimensional (4D) echocardiography and 3D MRI

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ABSTRACT BODY:

Objectives: Some fetal conditions, such as isolated severe pulmonary stenosis and pulmonary atresia, if untreated prenatally, will result in fetal/neonatal deaths or significant morbidity. If promptly treated in utero, babies affected would not only survive, but could also live with nearly normal life. But intrauterine surgery is a highly risky procedure, requiring sophisticated training and planning.

Methods: 3D body models were formed from 3D fetal MRI datasets. 4D fetal echo datasets were segmented to create 4D cardiac models. Atretic pulmonary valve (PaV) was re-created using the models and post-mortem data. After combining the models into a single VR system, simulation of pulmonary valvuloplasty was performed using a virtual catheter.

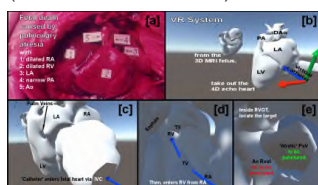
Results: Work in progress has shown it is feasible for the catheter to walk through various cardiovascular structures. The catheter can enter from the inferior vena cava (IVC) into the right heart till reaching the right ventricular outflow tract (RVOT). After confirming appropriate location, the catheter can "puncture" the atretic PaV, and get into the narrow but patent pulmonary artery (PA). A retrograde path can also be simulated from the descending aorta through the ductus arteriosus into the PA, then through the atretic valve into the RVOT.

Conclusions: Using quality multimodal 3D/4D imaging and VR, it is possible to simulate in utero cardiac procedures. The next stage of development will be to provide the physical sensation of manoeuvring the catheter through a rapidly beating heart. This technique has broad application and can be developed for training in other fetal interventions, e.g., treatment of diaphragmatic hernia or fetoscopic surgery for spina bifida.

Additional details

KEYWORDS: Fetal heart, 3D/4D, Virtual reality, Magnetic resonance imaging.

(No Table Selected)



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Extra Info: Jing Deng:27 April 2021

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